In the upper jaw the first incisor is short, and almost imperceptibly larger than the other incisors. Canine long and curved. The premolars form an almost unbroken series with the canine and first molar. First premolar very small, scarcely higher than fourth incisor; second a little larger; third premolar the largest, the middle cusp being as high as the molars. The molars are rather feeble, with relatively low crowns and blunt cusps; last molar very narrow.

In the lower jaw the canine is a little shorter than that in the upper. Fourth molar only a little smaller than third. Incisors and premolars as in upper jaw.

Compared with *Ph. minima* the brain-case is higher, but narrower, and the *arcus zygomaticus* longer. *Ph. apicalis* has larger *bullæ osseæ*, but shorter *foramina incisiva*; the third premolar in that species is almost rudimentary, and the second premolar larger than the two other premolars together. In both these species the crests on the brain-case are scarcely developed, and the postorbital processes wanting.

Hab. Herbert Vale, Northern Queensland; one specimen, a full-grown male, collected by Dr. Lumholtz, January 1883, is preserved in the Zoological Museum at Christiana.

The specimen was dug out from a hole in the ground, and its habits seemed not to be arboreal[1].

Christiania, 15th November, 1886.

EXPLANATION OF PLATE LX.

Fig. 1. *Phascologale virginiæ*, natural size.
2. Skull, natural size.
3. Canines and premolars, three times natural size.

December 21, 1886.

Prof. Flower, LL.D., F.R.S., President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of November 1886:—

The total number of registered additions to the Society's Menagerie during the month of November was 166, of which 64 were by presentation, 22 by purchase, 16 by birth, 4 were received in exchange, and 60 on deposit. The total number of departures during the same period, by death and removals, was 107.

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[1] My friend, Mr. Oldfield Thomas, informs me, on the authority of M. Huet, of Paris, that the original type of this species, the locality of which was unknown, appears to have been lost; and as the animal has been overlooked ever since its first description, I have thought it worth while to figure and redescribe it from the beautiful specimen obtained in Queensland by Dr. Lumholtz.

Mr. Howard Saunders, F.Z.S., exhibited on behalf of Mr. R. J. Howard, of Blackburn, a specimen of a hybrid between the Tufted Duck (*Fuligula cristata*) and the Pochard (*F. ferina*), bred in Lancashire; and read the following extract from a letter addressed to him by Mr. Howard on the subject, dated Fern Bank, Blackburn, Oct. 28th, 1886:—

"I have forwarded for your acceptance a hybrid between the Pochard and the Tufted Duck, knowing that an authenticated specimen will be of interest; for I suppose I must take it for granted that the bird referred to by you in the 4th edition of 'Yarrell' (vol. iv. p. 433) as 'apparently a hybrid between the Tufted Duck and Pochard' is the only one known to you.

"A pinioned pair of Pochards first bred at Woodfold Park in 1882, since which date several broods have been annually reared there ('Yarrell,' vol. iv. p. 414). I found the Tufted Ducks nesting on the same reservoirs in July 1884, some of the young birds being subsequently captured, pinioned and turned down again (ibid. p. 431); the first recorded instance of the breeding of the Tufted Duck in Lancashire. The birds of both species leave the reservoirs during the severe weather of winter.

"On the 9th of May last, I saw a male Pochard apparently paired with a pinioned female Tufted Duck. On the 23rd of the same month two male and one female Tufted Ducks appeared; the male Pochard would not allow the male Tufted Ducks near the pinioned female, but drove them off if they approached within 30 or 40 yards. Soon after this all the drakes left, and I saw little of the ducks until the 20th June, when both appeared on the water; the full-winged female Tufted Duck with a brood of 9, the pinioned one with 10 young hybrids.

"From the first I could easily distinguish the pure-bred young from the hybrids: the upper parts of the former being uniform umber-brown, whilst the latter had the cheeks and throat buff. As the birds began to feather, I noticed that the hybrids were bulkier, the general appearance being more that of the Pochard than of the Tufted Duck; the head, neck, and upper surface were of a much lighter and warmer brown, the feathers about the base of the upper mandible rather lighter-coloured than the rest of the head, but not showing a distinct patch as in the Tufted Duck. We caught two hybrids on the 30th July, and put them on the reservoir in the Blackburn Corporation Park; and on the 2nd August I sent two, in the name of Mr. Thwaites (to whom I am indebted for permission to deal with the birds as I wish), to the Zoological Society's Gardens. Their description is as follows, the sex being uncertain:—Length 15·5 and 15 in.; bill dark blue, almost black, 1·6 in. in length, and a trifle more dilated towards the point than in the pure Tufted Duck; irides yellowish brown; legs and toes blue, darkest at joints, webs black. Two of the young Tufted Ducks, male and female, caught on the 31st July: length 14·5 and 14 in.; bill black, 1·5 in. in length; irides dull yellow; legs and toes as in the above hybrids.

"The bird which I sent you was shot on the 19th August, being

then strong on the wing, and proved, on dissection, to be a male. Those which I put on the reservoirs in our Corporation Park do not appear to have changed in plumage; there is not as yet the slightest sign of a crest."

The above rare hybrid has since been presented to the British Museum of Natural History.

The following papers were read:—

1. On Atavism. A Critical and Analytical Study. By J. Bland Sutton, F.R.C.S., Lecturer on Comparative Anatomy, Middlesex Hospital, Erasmus Wilson Lecturer on Pathology, Royal College of Surgeons.

[Received October 22, 1886.]

In an interesting paper entitled "Critical Remarks on Polydactyly as Atavism," Gegenbaur enters into a masterly discussion of this confessedly difficult subject, and, in the course of summing-up, he ventures to divide atavistic phenomena into two groups—Palæogenetic and Neogenetic.

Atavism he defines as "a re-appearance of a more primitive organization, or a reversion (*Rückschlag*) to a primary state." To choose an example:—the occasional presence of an *os centrale* in the adult human carpus is a reversion to a condition very prevalent in the lower Mammalia. We know that a cartilaginous representative of this ossicle is easy of detection in the embryo; but Atavism does not consist in the existence of a latent germ, but in its becoming perfected and further developed.

In this case the atavistic part exists, by law of inheritance, in the early embryo as a germ which normally disappears, but in some cases becomes further developed. This is Gegenbaur's Palæogenetic Atavism. If the abnormal part (using the term abnormal in its most literal sense) is not found as a germ in the embryo, the reversion is "Neogenetic."

My object is to show that all examples of atavism belong to the Palæogenetic group and that Neogenetic Atavism has no existence.

The question of polydactyly I do not intend to discuss, but shall select the foot of the Horse, as Gegenbaur has done, to serve as illustrations of the principle, and thence extend the view broadly.

The descent of the modern Horse from five-toed ancestors is beyond all question. That the animal of to-day walks on an enlarged third digit with a rudimentary digit on each side in the manus and pes is accepted doctrine. The comparative recent ancestors of the Horse were tridactyle. Gegenbaur states that Hensel's[2]

[1] Morph. Jahrbuch. Bd. vi. S. 584–596. A translation by Drs. Garson and Gadow is given in 'Journal of Anatomy and Physiology,' vol. xvi. p. 615.

[2] "Ueber *Hipparion mediterraneum*." Abk. k. Akad. d. Wissensch. z. Berlin, 1861, S. 66.

investigations point to the probability that the finger typically attached in *Hipparion* to the medial styloid bone was the last to abort. It is certainly noteworthy that in the majority of cases of polydactyly occurring in Horses it is this digit which reappears most frequently.

In the Teratological Gallery in the Museum of the College of Surgeons several specimens of Horses' feet are shown with a well-developed second digit. Cheauveau figures [1] a specimen preserved in the Veterinary Museum at Lyons; but the most complete case of its kind is that figured and described in Prof. Marsh's paper [2] "On Polydactyle Horses, Recent and Extinct." In this instance the inner digit was present on the four feet. Besides giving an interesting account of extra digits noticed by early writers, this eminent palæontologist tells us that the more frequent occurrences of extra digits on the manus is precisely what a study of fossil forms of equine mammals would lead us to anticipate.

These cases support the view as Gegenbaur points out, that the atavistic parts do not belong to forms palæontologically remote or systematically far distant.

In the Spider-Monkey the thumb is normally absent, or represented merely by a nodule of cartilage or fibrous tissue. Yet on one occasion I dissected an *Ateles paniscus* which had on each hand a perfectly developed thumb. This condition is not very uncommon. If the parts be dissected in normal specimens, the thumb is represented by a band of cartilage and fibrous tissue attached to the trapezium. The illustrations which have been used were selected merely to give a clear notion of genuine Atavism—the palæogenetic form. The question of polydactyly is in some instances susceptible of another explanation, which I do not propose to speak of in this paper.

Atavism in relation with the Prostate.

Leaving the skeleton, attention will now be invited to a remarkable instance of Atavism presented by the prostate. In structure and intrinsic relations this organ presents some exceptional features. It is best regarded as a capsule composed of fibrous and unstriped muscular tissue, mixed with tubular glands, surrounding a recess known as the utriculus masculinus. The utriculus separates the termination of the confluent ducts of the vesiculæ seminales and vasa deferentia, whilst it is tunnelled near its anterior aspect by the commencement of the urethra. The glands of the prostate are best considered as tubular alveoli which unite into a smaller number of excretory ducts (about twenty) opening in two depressions of the urethra known as the prostatic sinuses. The tubules are lined by columnar epithelium.

The central recess before mentioned has been named the sinus

[1] 'Anatomie Comparée.'

[2] American Journal of Science and Art, vol. xvii., June 1879.

pocularis, utriculus, or uterus masculinus. Usually it is nearly half an inch long, and opens by a narrow slit in the middle of the caput gallinaginis. It is lined by mucous membrane continuous with that of the urethra, and covered by stratified epithelium. Some small tubular glands open on the free surface of the mucous membrane.

This utriculus is of great interest morphologically, as it represents in the male a persistent portion of the confluent segment of the Müllerian ducts. Weber regarded it as corresponding with the uterus, but Leuckart showed that a part of it must be looked upon as representing the vagina.

My observations induce me to regard the prostate as a suppressed uterus, the fibro-muscular tissue representing the matricial walls, the follicles correspond to the utricular glands, and the utriculus is identical with the cervix uteri and that portion of the vagina immediately adjacent.

The evidence in support of this view will now be put before the reader. In order to render every detail in clear light, we must refer briefly to the fundamental structures concerned in forming a functional uterus.

In the Lizard, in common with the majority of the Sauropsida, the ova are conveyed to the exterior by two muscular tubes lined with mucous membrane, known as oviducts. The eggs, when they escape from the ovaries, are received by the dilated end of the oviduct, known as the infundibulum, and quickly passed onwards; they receive at the commencement of the journey a coating of albumen. Pushed on by the contortions of the tube, they arrive at the third or uterine portion. Here they receive a coating of calcareous matter known as the shell, and are then ready for expulsion. In these oviducts, with their mucous membranes and glands, we have the fundamental condition of the ducts which in the human embryo conspire to form the uterus with its Fallopian tubes and vagina.

In order to clearly describe the manner in which the Fallopian tubes, uterus, and vagina are formed from the Müllerian ducts of opposite sides, each duct may be conceived as made up of three parts:—

The upper third becomes the Fallopian tube; the funnel-shaped and usually fimbriated extremity communicates with the peritoneal cavity. The middle portions of the ducts fuse together, and form the fundus, body, and neck of the uterus, whilst the lower thirds of the Müllerian ducts form a vagina. Such is the commonest arrangement.

On comparing the parts of this compound organ with the Lizard's oviduct, it becomes evident that the infundibulum and albumen segment in the bird represent the Mammalian Fallopian tube, the second or uterine portion corresponding with the uterus and vagina of Eutheria.

On tracing the homologies closer, we find that the portion of the bird's oviduct concerned in secreting albumen corresponds with that portion of the Müllerian duct which forms the fundus and body of the uterus; and the utricular glands, which are concerned in

secreting a thick, viscid, albuminous material, are simply modifications of the simple recesses found in the bird's oviduct. The third, or uterine section of the oviduct, corresponds to the cervix of the uterus and the vagina. To this we shall return. In the male of the higher mammals, theMüllerian ducts by their fusion give rise to the utriculus. This cavity is formed by that portion of the ducts which in the female constitute the cervix uteri and upper segment of the vagina.

Excellent confirmatory evidence of this view is afforded by a rare malformation to which the prostate is liable. Instead of the Müllerian ducts disappearing after the posterior portions have fused to form the utriculus, a segment of each may persist, so as to give rise to a bicornuate utriculus, in fact a miniature uterus. In rarer instances a Müllerian duct may persist through its entire length. Such a case has been described by Dr. Ord [1]. There is good reason to believe that some examples described as double ureters were of this nature.

If the human prostate be examined by cutting it into slices in the direction of the urethra, at any age after puberty, but much more easily at fifty years, small brownish or black bodies, usually of the size of poppy-seeds, will be detected. These bodies, familiar as prostatic concretions, are, as a rule, very much smaller in young subjects, in whom it is often necessary to scrape the cut section of the lateral lobes of the prostate, and submit the juice to microscopic examination in order to detect them. Before puberty they are practically absent; in old age they may attain the dimensions of split peas.

In number they may vary from twenty to two thousand; in size from $\frac{1}{1000}$ of an inch to that of a cherry-stone; in colour bright red, brown, or even black. In consistency they may be soft, hard, or even brittle. Chemically they contain organic matter, about one half, the rest being made up of phosphate and a small quantity of carbonate of lime.

For a careful and detailed account of prostatic concretions, the student should consult an excellent paper by Sir Henry Thompson, entitled, "Some observations on the Anatomy and Pathology of the Adult Prostate" [2].

In the preceding pages an endeavour has been made to prove that the cervix of the uterus and contiguous portion of the vagina correspond to the shell-forming segment of the bird's oviduct. The prostate and utriculus correspond to the uterine cervix and upper part of the vagina, therefore they are homologous with the shell-forming segment of the bird's oviduct.

The shell of an egg consists of animal matter impregnated with salts of lime, and is due to the activity of the glands in the third section of the oviduct. Prostatic concretions are due to the activity of the glands lodged in the prostate. The inference is clear that prostatic concretions and egg-shells agree structurally and chemically, and are produced by homologous organs. Thus man has in his

[1] Medico-Chir. Trans. vol. lxiii. p. 11.
[2] Medico-Chir. Trans. vol. xl. p. 78 (1857).

prostate an unimpeachable witness of an ancestry with the feathered tribe, low down among the oviparous reptiles.

Let me now proceed to show how very little information we possess concerning latent germs which may be present in the embryo. For example, the discovery of the germ of an *os centrale* in the carpus of man was certainly startling. Yet its existence might have been anticipated from what we know of the variations in the number of the carpal ossicles in the adult. Atavism drew the attention of anatomists to a secondary astragalus in the human tarsus, and Bardeleben succeeded in detecting the germ. (This has been questioned by Baur, but his objections are inconclusive.) We must now consider some cases of a different character.

Atavism in relation to Secondary Sexual characters.

As Darwin points out [1], two distinct elements are included under the term "inheritance"—the transmission and the development of characters. The distinction is a most important one, especially in its bearing on the question of Atavism, that the two conditions will be illustrated by concrete examples.

In most species of the Deer tribe it is the rule for the male alone to possess antlers, yet it is a well attested circumstance that under certain diseased conditions of the sexual organs, especially atrophy or degeneration of the ovaries, rudimentary horns which are never shed appear in the female.

This shows us that although the female is in possession of the secondary sexual organs in virtue of *transmission*, yet they remain latent as a rule, and only become developed under extraordinary circumstances. The same holds good for those cases of hens who for years lay eggs, yet eventually cease to do so, put on one side the plumage proper to their sex, and adopt more or less completely the plumage of the cock.

These examples open up the subject of secondary sexual characters. The question of primitive hermaphroditism has been already discussed in a preceding paper, and an attempt was made to show that, for a brief period at least, the embryo presents sexual parts common to the male and female, so that for a time it is absolutely impossible to determine the sex. What is true of the embryo applies equally to animals normally hermaphrodite: no distinctive characters are displayed externally. Also in cases of hermaphroditism occurring in animals normally bisexual, the secondary sexual characters are intermediate to those of the functional male and female. It is therefore fairly evident that the female, though she differs from the male in the non-development of secondary sexual characters, yet possesses them in a latent condition; or, to put the matter briefly, they are transmitted, but not developed.

This raises two questions, each of equal importance:—(1) How are these characters transmitted? (2) What hinders their development?

It seems to me that the second of these questions is the one with which we are chiefly concerned here, and that the non-development of

[1] 'Descent of Man,' 2nd ed. p. 227.

secondary sexual characters can be explained on the principle known as the "Correlation of Organs."

In order, however, to render this explanation tenable, it will be absolutely necessary to prove, as far as possible, that the germs of secondary sexual organs, which only manifest themselves occasionally in the females of dimorphic forms, are really inherited; and, if the female is furnished with the germs of these structures, to show by what method they are transmitted. It is to this somewhat intricate part of the question that we must now direct our attention.

If a careful analysis be made of those structures which constitute secondary sexual characters, we shall find that they are almost entirely developed in connection with the integument. The majority—whether they be horns, bristles, spurs, or teeth, for attack or defence; or exuberance of hair, feathers, wattles, combs, &c., for æsthetic purposes,—the integument and the immediately subjacent tissues are responsible for them.

In the earliest embryos of most mammals we distinguish at a very early stage two layers of cells, known as the epiblast and hypoblast. In most of the Metazoa a new layer is interposed known as the mesoblast; this originates in part from the epi- and in part from the hypoblast. It is the epiblast and the portion of mesoblast immediately adjacent that furnishes secondary sexual organs. From whence is the epiblast derived?

We know now that the essential act of impregnation consists in the union of a spermatozoon with an ovum; the head of the spermatozoon constitutes the male pronucleus, the germinal area the female pronucleus. After the pronuclei have united segmentation begins, and the formation of the fundamental layers is quickly brought about. There are good grounds for believing that the initial streak indicating the commencement of segmentation really marks the line of fusion between male and female pronuclei.

If we measure the size of the head of a functional spermatozoon, it will be found equal to $\frac{1}{6000}$ of an inch, whereas the germinal area of the ovum equals $\frac{1}{500}$ of an inch. It is a very significant fact that the segments which give rise to the epiblast are smaller than those which furnish the hypoblast and mesoblast; to this there are very few exceptions. This is exactly what might be expected, the halves of a globe $\frac{1}{6000}$ of an inch in diameter would certainly be smaller than the halves of a sphere one twelfth the size.

The facts at our disposal seem to point to the conclusion that the epiblast is chiefly derived from the male element, while the female pronucleus is responsible chiefly for the hypo- and greater portion of the mesoblast.

If this be true, the transmission of characters peculiar to the male is not so obscure as many have supposed.

We must now inquire how it is, that if the female possesses all the secondary sexual characters of the male in a latent manner, what is it that prevents them manifesting themselves.

When differentiation of sexes occurs in animals previously hermaphrodite, it involves either the loss of certain characters on the

part of the female, or the acquisition of new characters by the male, or at any rate increased functional importance of certain organs possessed, when in the state of hermaphroditism, by all the forms. By natural selection the male would acquire (or, if already in his possession in a functional condition, they would become more developed) means for seizing and retaining the female, such as the claspers of sharks, the callous pads of frogs, &c. Paternal duty requires the male to protect the young and defend the females from harm; hence horns, teeth (as in the musk-ox), spurs, tusks, &c. become more developed in him.

The duties of the female require her not only to furnish the material out of which the young are to be formed, but in many cases she is required to provide them with nutrition long after they enter the world. The material which the female thus provides is of the very kind necessary, in many instances, to build up such structures as horns, tusks, teeth, and the like. Further, this material is required by the female at the corresponding period of life in which they become developed in the male, viz. on the advent of puberty. We may state with certainty that a distinct correlation exists between the generative organs of the female and the development of the secondary sexual male characters. The more developed and functional the female reproductive organs become, the less likely is she to manifest the secondary characters of the male. It may be argued, that in some cases the female simulates the male, as in the few examples of female Deer possessing horns. Quite true; but so long as the female is engaged in the duties of reproduction, these secondary characters are never developed to the same extent as in the functional male. It must also be borne in mind, that in cases where sterile females, or those which have ceased to bear young, put on external male characters, they rarely attain such proportions or beauty as in the male; for in the males the general excitement produced upon the system by sexual passion has a most powerful stimulant effect upon the growth and development of these structures, which is wanting in the female. So that in her attempts to emulate the male she succeeds to a certain degree, but rarely, if ever, attains to so good a condition.

Hunter has recorded some experiments which have a bearing on this matter:—

"I wished also to ascertain if the parts peculiar to the male could grow on the female, and if the parts of a female, on the contrary, would grow on a male.

"Although I had formerly transplanted the testicles of a cock into the abdomen of a hen, and they had sometimes taken root there, but not frequently, and then had never come to perfection, yet the experiment could not, from this cause, answer fully the intended purpose; there is, I believe, a natural reason to believe it could not, and the experiment was therefore disregarded. I took the spur from the leg of a young cock, and placed it in the situation of the spur in the leg of a hen-chicken; it took root, the chicken grew to a hen, but at first no spur grew, while the spur that was left on the

other leg of the cock grew as usual. This experiment I have repeated several times in the same manner, with the same effects, which led me to conceive that the spur of a cock would not grow upon a hen, and that they were, therefore, to be considered as distinct animals, having very distinct powers. In order to ascertain this, I took the spurs of hen chickens and placed them on the legs of young cocks. I found that those which took root grew nearly as fast, and to as large a size as the natural spur on the other leg, which appeared to be a contradiction to my other experiments. Upon another examination of my hens, however, I found that the spurs had grown considerably, although they had taken several years to do it; for I found that the same quantity of growth in the spur of a cock, while on the cock, during one year, was as much as that of the cock's spur on the hen in the course of three or four years, or as three or four to one; whereas the growth of the hen's spur on the cock was to that of the proper spur of the hen as two to one."

When a female animal belonging to a dimorphic species assumes male characters, it is truly an example of Atavism, or development of transmitted characters normally latent.

This part of the matter has been dwelt upon at some length for the following important reason. If we regard the epiblast and the structures developed therefrom as representing the chief characters derived from the male parent, it opens up a field of interesting inquiry in clinical medicine and pathology regarding hereditary diseases, and it demonstrates clearly enough that we have little knowledge concerning the germs of organs which may be latent in an animal; therefore Neogenetic Atavism is, at its best, exceedingly questionable. To assume that such a form of Atavism exists, is to believe in the sudden development of new characters: this is totally opposed to the fundamental principles of Evolution.

The question is one of great importance to the pathologist, inasmuch as there is very great probability that many aberrations of organs and tissues are atavistic in their nature.

2. On the Systematic Position and Classification of Sponges. By R. v. Lendenfeld, Ph.D., F.L.S., Assistant in the Biological Laboratory of University College, London.

[Received December 20, 1886.]

I. Introductory Remarks.

Our knowledge of the development and structure of Sponges is of such recent date that we have hardly had time to utilize it for systematic purposes till now.

Whilst the anatomical and embryological work of recent authors, particularly of F. E. Schulze and his pupils, has made us acquainted with the structure of Sponges in a satisfactory manner, our knowledge of species, which was formerly practically confined to those from the Mediterranean and the Atlantic, has been greatly extended by the collections made during the voyages of the 'Alert' and 'Challenger' in all parts of the world, and by my own labours in the Australian seas.

I think, therefore, that the time has now arrived to endeavour to establish a classification of Sponges, and to discuss the position which the Sponges, as a group, occupy in the scale of Nature.

In an Appendix to this paper a nearly complete list of publications on Sponges is given. It has been made by interpolating old, new, and omitted papers in D'Arcy Thomson's (1495) list of 551 papers, the references in which have been verified. I must express my thanks to Mrs. v. Lendenfeld and to Mr. A. Dendy for their share in this work, and also to Mr. Ridley for his kindness in allowing us to use his most valuable MS. notes on this subject.

In the section on the systematic position of Sponges, the principal views held on the subject are discussed, and reasons are given for considering the Sponges as the first Phylum of the Grade Cœlentera, which arrangement has been adopted in this paper.

The main classification of the Orders is the result of my own anatomical work, and has been arrived at independently of other authors. It affords me much pleasure to state that this classification is, in the main, similar to that established by Vosmaer (1550), although we have arrived at our results in different ways, and our diagnoses differ accordingly.

To that section of this paper which deals with the arrangement of the Families and Subfamilies, and the enumeration of the principal Genera, Mr. A. Dendy has contributed the portions relating to the Suborders Clavulina and Halichondrina with the exception of the Tethydæ and Chalininæ. The portions relating to the Hexactinellida and Tetractinellida are compiled from the recent papers of Schulze (1369), Sollas (1453), Vosmaer (1550), and Zittel (1639). The remainder is based on my own MS. notes.

II. Nomenclature of the Spicules.

Various terms for the spicules found in Sponges have been used by different authors. In consequence of this a certain confusion has arisen with regard to the meaning of the terms employed. Vosmaer (1550) made a chivalrous attempt to establish a satisfactory Nomenclature, which, however, has unfortunately not been accepted by recent authors on Sponges except myself, so that it only added to the already existing confusion.

Recently Sollas, Ridley, and Dendy have established a new nomenclature for Monaxonid spicules, which I have agreed to adopt, and which has been used by them and myself. I do not think it perfect, but I am certainly not in a position to replace it by anything better, and therefore adopt and explain it in this paper. Schulze's nomen-

clature of Hexactinellid spicules is here, of course, accepted *en bloc*, and his terms will be defined below. Sollas (1453) has used a number of terms in his preliminary report which I do not understand and which presumably nobody else understands either. It is, therefore, much to be regretted that the greater part of them are unexplained. In consequence of this I will, for the present, abstain from attempting to compile a nomenclature of Tetraxonid spicules pending the publication of Sollas's full report, in which, we may hope, he will explain his new terms.

The spicules of Sponges are, as a rule, of such shape that they appear as more or less modified geometrical figures with definite axes. The axes are always represented by a non-skeletal rod (the so-called axial canal), round which the silica or lime is precipitated in concentric layers. There may be one such axis, or there may be more than one.

Häckel (627) drew attention to this crystalline regularity of sponge-spicules, which has been of great importance in studying the skeletal elements of Sponges.

We can divide the sponge-spicules, as we do the Sponges, into the two groups Calcarea and Silicea, according to their chemical composition. Within each group we distinguish series of forms according to the number and position of the axes. The validity of this classification is proved by the correlation of these different kinds of spicules with other organs in the Sponges.

The following are the different kinds of spicules :—

I. Group Spicula Calcarea.

Composed chiefly of carbonate of lime.

1. *Monaxonia.*

With one straight or curved axis, rod-shaped.

2. *Triaxonia.*

With three distinct axes which may lie in one plane or not. When one of the rays of this tri-act spicule becomes rudimentary, Diaxonia can theoretically be produced. It is, however, advantageous to consider the Diaxon spicules as part of the Triaxonia. The calcareous triaxon spicules have only three rays—triact.

3. *Tetraxonia.*

With four axes and four rays—tetract. The points form the corners of a triangular pyramid. Generally three axes, or rays, are equivalent (tangential), and one (radial) is differentiated, longer or shorter than the others.

II. Group Spicula Silicea.

Composed chiefly of silica.

1. *Anaxonia.*

Without definite axes and with numerous rays—polyact.

To this group belongs one kind of spicule only, namely the stellate and its derivatives.

The following six forms can be distinguished :—

A. *Regularia.*

The rays radiating from one point.

1. *Oxyaster.*

With long, slender, pointed rays (*e. g. Stelletta*). = *st*, Vosmaer.

2. *Euaster.*

With stout, pointed, conic rays (*e. g. Chondrilla*).=*gl. st*, Vosmaer.

3. *Spheraster.*

The rays coalesce to form a solid ball (*e. g. Geodia*).=*gl*, Vosmaer.

B. *Irregularia.*

The centre extends to form a line which may be curved, circular, ring-shaped, or spiral.

4. *Spiraster.*

A stout spiral with thick spines attached (*e. g. Raphyrus*). = st^2, Vosmaer. When spines terminal, *Amphiaster.*

5. *Corona.*

A spined ring (*e. g. Suberocorona*) (?).

6. *Spirula.*

A spiral without spines (*e. g. Spiretta*).

These anaxon spicules never form part of the supporting skeleton, but are invariably flesh-spicules (*Microsclera*).

2. *Monaxonia.*

With one straight or curved axis, sometimes with lamellar outgrowths.

A. *Supporting Spicules* (Megasclera).

1. *Strongylus.*

A cylindrical rod rounded at each end (*e. g. Uruguaga*). = tr^2, Vosmaer.

2. *Oxystrongylus.*

A cylindrical rod abruptly pointed at each end (*e. g. Pachychalina*).

3. *Oxyus.*

A gradually pointed, spindle-shaped spicule (*e. g. Spongilla*). = *ac*, *ac*, and ac^2, Vosmaer. Diact, F. E. Schulze.

4. *Tylotus.*

A cylindrical rod with a knob at each end (*e. g. Crella*). = tr^{02}, Vosmaer.

5. *Tylostylus.*

A cylindrical rod more or less pointed at one end and knobbed at the other (*e. g. Suberites*). = tr^{0} *ac*, Vosmaer. Without knob, *Stylus.*

B. *Flesh-Spicules* (Microsclera).

6. *Toxius.*

Curved in the centre, the two ends in a straight line, thus  (*e. g. Toxochalina*).=  , Vosmaer. When in bundles, *Toxodragmata.*

7. *Sigmata.*

S-shaped, curved irregularly, not expanded in one plane (*e. g. Geliodes*).=  , Vosmaer. When in bundles, *Sigmadragmata.*

8. *Isochelæ.*

Curved spicules with flat expanded ends extending in the surface of a rotation ellipsoid ; both ends equal (*e. g. Desmacidonidæ*). $=anc^2$, Vosmaer. Anchorates, auctorum.

9. *Anisochelæ.*

Curved spicules with flat expanded ends extending in the surface of a rotation ellipsoid ; ends unequal (*e. g. Desmacidonidæ*). $=anc$, *anc*, Vosmaer. Anchorates, auctorum.

10. *Diankistra.*

A rod with a hook at each end, divided by a remarkable incision (*e. g. Vomerula*).=  Vosmaer. Bundles of hair-like spicules, *Trichodragmata.*

3. *Triaxonia.*

Spicules with three axes and six rays and their derivatives. (For details compare F. E. Schulze's preliminary report.)

1. *Oxyhexact.*

With six pointed rays, the ends of which form the corners of a double square pyramid. The rays represent the crystalline axes.

2. *Oxypentact.*

One ray rudimentary, representing the axes of a simple square pyramid.

3. *Oxytetract.*

Two rays rudimentary, representing the *edges* of a square pyramid.

4. *Oxydiact.*

Four rays rudimentary, only two rays lying in one straight line remain.

5. *Hexaster.*

A star with six, generally equal rays:—

a. *Oxyhexaster.* Rays pointed.
b. *Discohexaster.* Rays terminated by disks.
c. *Floricome.* Rays terminated by a bunch of curved branches.
d. *Graphiohexaster.* Rays much curved.
Plumicome. Rays terminated with a number of plumose branches.

6. *Pinnulæ.*

A star with five or six rays. One of them is particularly highly

developed and branched or covered with disks or scales. The opposite ray smooth or absent. The other four equal (tangential).

7. *Scopulæ.*

Fork- or broom-shaped spicules consisting of a long shaft traversed by an axial rod, to the distal end of which some, generally four, slender anaxial rods are attached.

8. *Amphidisc.*

A rod with an umbrella-shaped disk at each end.

9. *Uncinatæ.*

A rod with recurved hooks throughout its entire length.

10. *Clavulæ.*

A rod pointed at one end and bearing a knob or disk at the other.

4. *Tetraxonia.*

With four axes radiating from one point. The ends of the spicules lie in the corners of a square pyramid and their derivatives.

A. *Tetractina.*

With four rays.

B. *Triactina.*

With three rays.

C. *Diactina.*

With two rays.

D. *Monactina.*

With one ray.

For the reasons given above, I shall abstain from describing the Tetraxonian spicules in detail. I will, however, mention the terms for spicules employed by Sollas in his preliminary report (1453). These, alphabetically arranged, are the following:—

Acerate (Monaxon).
Acerella (Monaxon ?).
Amphiaster (?).
Amphiastrella (Spirastrella ?).
*Amphitetrad.
*Anchors.
Anthaster (?).
Arculus (?).
*Bifurcated Forks.
Calthrops (?).
*Candelabra.
Chiaster (?).
Cylindrical spicules (Monaxonia ?).
Echinella (?).
Ectaster (?).
Erdaster (?).
*Forks.
*Forks with trifurcate arms.
*Fusiform Acerates (Monaxonia).
Globate (Scleraster).
Globules (?).
Hispidating Acerate (Monaxonia).
*One-pronged (unicellate) Forks.
*Porrectate Forks.
Pycnaster (?).
*Radical Anchors.
Sigmella (?).
*Somal Anchor.
*Somatic Anchor.
Spinispirulæ (Spirastrella).
Spirulæ (Spirulæ).
Stellate (?).
*Tetrad.
*Triona.
Trichite Acerates (Monaxonia).
*Trichite Forks.
*Trifid Forks.
*Two-pronged (dicellate) Forks.

The names marked * presumedly apply to Tetraxon spicules. The others probably belong to different groups.

These pages will give a key to the terms of spicules used below.

There are, however, a number of other terms which require explanation.

The spicules are divided generally into two distinct groups :— (1) Those which together form the supporting skeleton of the sponge : these are called Supporting spicules or Megasclera. (2) Those which lie scattered in the ground-substance and which differ from the former in shape: these are called Flesh-spicules or Microsclera (Tension-spicules of Bowerbank).

F. E. Schulze (1369) uses particular terms for spicules according to their position, which have been adopted in this paper so far as the Hexactinellids are concerned.

These are alphabetically the following :—

Autodermalia. Spicules on the outer surface with free projecting and with centripetal (immersed) differentiated rays.

Autogastralia. Spicules on the gastral surface with free projecting and with centrifugal (immersed) differentiated rays.

Basalia. Spicules of the root-tuft.

Comitalia. Spicules accompanying the fibres.

Epidermalia. Spicules on the outer surface with free projecting differentiated ray only.

Epigastralia. Spicules on the gastral surface with free projecting differentiated ray only.

Hypodermalia. Spicules of the outer surface with immersed radial ray only.—Pentact.

Hypogastralia. Spicules of the gastral surface with immersed radial ray only.—Pentact.

Marginalia. Spicules forming a collar round the osculum.

Parenchymalia. Spicules in the interior.

Pleuralia. Spicules forming a fur.

Principalia. Spicules of the main skeleton.

III. The Systematic Position of Sponges.

The opinions of different authors on this subject diverge considerably. I shall attempt to reconcile them in the following pages and to prove the correctness of the result at which I have arrived.

Aristotle first pointed out that the Sponges were not plants—a fact which seems clear enough now, but which was doubted and combated by most authors of the dismally ignorant middle ages. This we admit as proved. I agree with Häckel in dividing the organic world into the three groups—Plants, Protista, and Animals. Among the Protista there are a great majority of forms showing affinities either to animals or to plants, so that it is not unusual to split up the Protista and divide its members among the two other old established groups. For the sake of simplicity I adopt this course here.

The Animal Kingdom, in this wider sense, including the animal Protista, is naturally to be divided into Protozoa and Metazoa, of

which the former consist of similar and equal, undifferentiated, cells, which often remain isolated throughout life, whilst the latter pass through a unicellular stage of short duration only, and consist, when adult, of a number of different cells. There is a vast difference between these two groups: the Protozoa are isocellular, whilst the Metazoa are heterocellular. The Sponges are developed in the same way as all other Metazoa and pass through the same well-known embryonic stages—the Morula, Blastula, &c. They consist, when adult, of a great number of differentiated cells. There are flat epithelial cells all over the outer surface and on the canal-wall; there are collar-cells round the ciliated chambers. There are gland-cells for different purposes, muscular and nervous cells besides ordinary tissue and amœboid cells in the Mesoglœa or ground-substance, in which also the ova and spermatozoa are developed. It is therefore quite clear that the Sponges are not Protozoa, but Metazoa, and are, in fact, not similar to Protozoa in any way.

The Metazoa are naturally divided into two Groups or Grades—the Cœlentera, with a simple undivided body-cavity, all the parts of which are in direct connection with one another; and the Cœlomata, which have two distinct and entirely separated body-cavities—a gastral cavity and a cœlom or perigastric cavity. The Sponges certainly have a simple and continuous body-cavity and no trace of a cœlom, so that they must be regarded as Cœlentera.

Long before Hertwig established the cœlom theory, Leuckart had already perceived this important fact, and placed the Sponges among the Cœlentera accordingly.

Although nobody has ever attempted to regard the Sponges as Cœlomata, there has been great opposition, principally among English authors, to Leuckart's opinion. I dismiss the arguments of those who, like James Clark (284–294), Carter (166), and Saville Kent (772), regard the Sponges as Protozoa, on the ground that their idea of Protozoa does not harmonize with the generally adopted meaning of the term, for if it did, they could not, as logical thinkers, count the Sponges among them. Their idea of Protozoa comprises the whole Animal Kingdom, because they draw no distinction between isocellular and heterocellular organisms, and of course all Metazoa are, if this distinction be omitted, colonies of unicellular Protozoa. F. E. Schulze (1361) has taken the unnecessary trouble to refute Saville Kent's (772) statements in detail, and to show that the latter had been guilty not only of levity in the philosophical treatment of his work, but also of recording incorrect observations.

Some very excellent men, particularly Balfour (17), Bütschli (138), and Sollas (1440), are inclined to consider the Sponges as a separate group equal in value to our groups Metazoa and Protozoa. This arrangement was arrived at without regard to the division of the Metazoa into Cœlentera and Cœlomata. They contrast the subkingdom Porifera (Parazoa, Sollas) with the subkingdom Metazoa as a whole. With all respect to the most important opinion of Balfour, I still do not see that there is any justification for the establishment of

a special Subkingdom for the Sponges. They are evidently Metazoa, and no doubt Cœlentera in the sense given above, namely the *Grade* Cœlentera as opposed to the *Grade* Cœlomata.

I think therefore that the Sponges form part of the *Grade* Cœlentera, and I do not believe that any one will raise any objection to this statement.

Now, however, we have to approach a much more difficult task, and that is, to ascertain what position the Sponges occupy within the *Grade* Cœlentera.

In this Grade we must place, besides the Sponges, one very well-defined group of animals (the Jellyfish, Hydroids, Corals, and Ctenophora) which is not connected with other animals by any intermediate form. There can be no doubt of the comparatively close affinity of all these, and the sharp distinction between them and the Sponges. In a like manner the Sponges are an exceedingly well circumscribed group, without any transitions in any direction to other animals. The Grade Cœlentera comprises, therefore, two well-defined groups:—(1) the Mesodermalia (910) or Sponges; and (2) the Epithelaria (910) or Nematophora (Lankester), Cnidaria (Claus), Telifera (Marshall), as they are variously termed.

A. In the Mesodermalia the archenteron communicates with the outer water by numerous small pores through which the water-current enters; and by one or a few larger pores termed oscula or vents, through which the water is expelled. It consists here of a branching canal-system.

In the Epithelaria there is no branching canal-system. The anus and mouth are not distingnished, and the mouth or mouths are equivalent to all the openings of the canal-system of sponges. Only exceptionally two different kinds of pores are met with, as in certain Actiniæ with terminally open tentacles; but there is no regular current of water through these pores.

B. The gastrula of the Mesodermalia is generally produced by invagination.

The gastrula of the Epithelaria, on the other hand, is generally the result of delamination.

C. The Mesodermalia have no movable appendages wherewith to catch their prey.

The Epithelaria have such appendages.

D. The Mesodermalia are not armed with cnidoblasts or their homologues.

The Epithelaria are defended by cnidoblasts or their homologues.

Although these differences are important, yet the principal distinction between these two groups, to which I drew attention at the last meeting of the British Association (Meeting 1886), is the following:—

E. The Mesodermalia have invariably simple ectodermal and entodermal epithelia, the cells of which are always flat pavement-cells, and never converted into muscular, glandular, sexual, or sensitive elements. The muscular, connective, slime-producing glandular, skeleton-producing glandular, sexual, sensitive, ganglionic and amœ-

boid cells met with in the Sponges are invariably modified cells of the mesoglœa. This is particularly striking and important in the case of the muscular and sensitive elements.

The Epithelaria, on the other hand, have a mesoglœa the cells of which remain more or less amœboid and are not differentiated to any extent. The muscular, glandular, sexual, sensitive, ganglionic and defensive nettle-cells are produced in the epithelia, they sink below the outer cell-layer with advancing development and lie on the surface of the mesoglœa or supporting lamella.

By a process of folding and subsequent coalescing of the fold-margins, bundles of muscular cells may become immersed in the mesoglœa, and so form a mesodermal structure, which, however, must be considered a secondary mesoderm, as compared to the primary mesoderm represented by the mesoglœa and its cells. But they are invariably produced first from the epithelia and immersed afterwards, and always retain their epithelial character in clothing the walls of tubular cavities in the mesoglœa. Single muscular cells are never surrounded on all sides by the mesoglœa. Solid bundles of muscular cells do not occur. Exceptionally nettle-cells (*Crambessa*) may be found in the mesoglœa, which is also here and there traversed by nerve-fibres (*Cycloneurous Medusæ*).

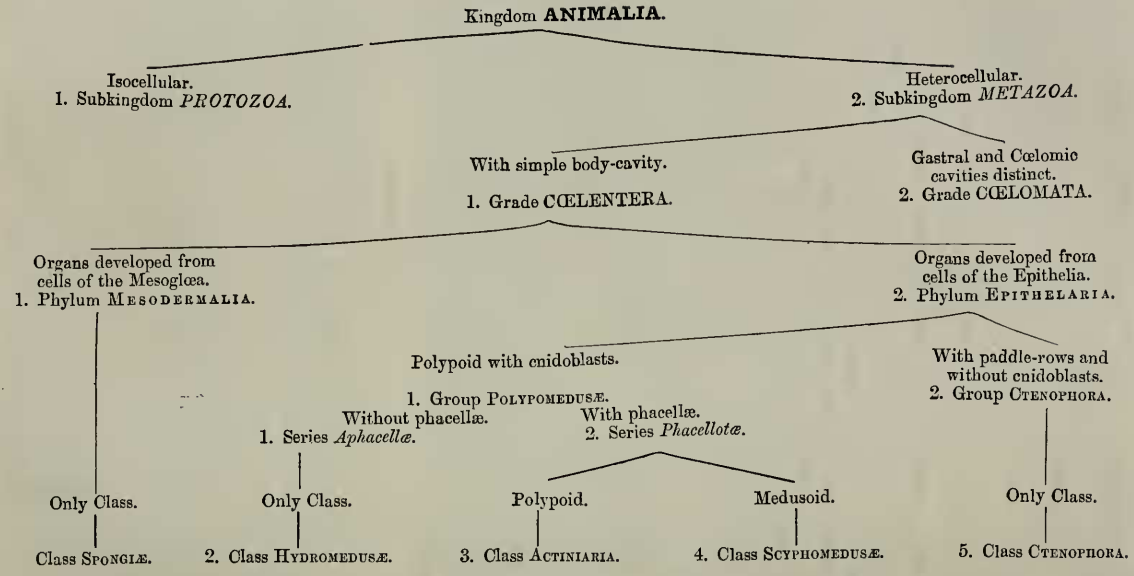
From a common sac-shaped ancestral form with simple ectoderm, simple entoderm, and undifferentiated cells in the intervening mesoglœa, representing the type of the Cœlentera, both Mesodermalia and Epithelaria have been developed. In the case of the Mesodermalia the cells of the mesoglœa became differentiated, and produced the organs, whilst the epithelia remained simple. In the case of the Epithelaria the cells of the mesoglœa remained unchanged and the organs were produced by the epithelia. I regard this as the principal difference dividing the two groups, and have therefore established the term Epithelaria in contradistinction to Mesodermalia (*l. c.*).

Having thus described the points of distinction, it remains that we should ascertain their phylogenetic value. There are only two alternatives with regard to the value we may attach to the Sponges as a group.

Either we must assume that within the Grade Cœlentera the Phylum Mesodermalia and the Phylum Epithelaria should be distinguished; or we may say that there is only one phylum in the Grade Cœlentera, namely the Phylum Cœlentera, and that this should be divided into the two Subphyla Mesodermalia and Epithelaria. It is evident that it comes much to the same thing. In this matter I adopt F. E. Schulze's opinion (1369), and consider the Sponges a separate phylum.

The result of this critical examination is given in the accompanying tabular view.

If we express this arrangement in the usual manner, we have :—


Kingdom ANIMALIA.
Isocellular.
1. Subkingdom PROTOZOA.
Heterocellular.
2. Subkingdom METAZOA.
With simple body-cavity.
1. Grade CŒLENTERA.
Gastral and Cœlomic cavities distinct.
2. Grade CŒLOMATA.
Organs developed from cells of the Mesoglœa.
1. Phylum MESODERMALIA.
Organs developed from cells of the Epithelia.
2. Phylum EPITHELARIA.
Polypoid with cnidoblasts.
1. Group POLYPOMEDUSÆ.
With paddle-rows and without cnidoblasts.
2. Group CTENOPHORA.
Without phacellæ.
1. Series Aphacellæ.
With phacellæ.
2. Series Phacellotæ.
Only Class.
Only Class.
Polypoid.
Medusoid.
Only Class.
Class SPONGIÆ.
2. Class HYDROMEDUSÆ.
3. Class ACTINIARIA.
4. Class SCYPHOMEDUSÆ.
5. Class CTENOPHORA.

Kingdom **ANIMALIA.**

I. Subkingdom *PROTOZOA.*

Animals which are either unicellular, or, if multicellular, isocellular, without archenteron.

II. Subkingdom *METAZOA.*

Multicellular, heterocellular animals with archenteron.

I. Grade CŒLENTERA.

Metazoa with simple body-cavity.

i. Phylum MESODERMALIA.

Cœlentera with branching canal-system, and organs developed from cells of the mesoglœa or primary mesoderm. No movable appendages.

1. Class SPONGIÆ.

With the characters of the phylum.

ii. Phylum EPITHELARIA.

Cœlentera with cæcal canal-system. The organs are developed from cells of the epithelia. With movable appendages.

1. Group POLYPOMEDUSÆ.

Polypoid Epithelaria with cnidoblasts.

i. Series *Aphacellæ.*

Polypomedusæ without entodermal phacellæ.

2. Class HYDROMEDUSÆ.

Aphacellæ of polypoid and medusoid character. Medusæ cycloneur.

ii. Series *Phacellotæ.*

Polypomedusæ with entodermal phacellæ.

3. Class ACTINIARIA.

Polypoid Phacellotæ with funnel and septa.

4. Class SCYPHOMEDUSÆ.

Medusoid Phacellotæ developed direct or from a *Scyphostoma* by strobilation. Toponeur.

II. Group CTENOPHORA.

Epithelaria with paddle-rows without cnidoblasts. Centroneur.

5. Class CTENOPHORA.

With the characters of the group.

II. Grade CŒLOMATA.

Metazoa with distinct gastral and cœlomic cavities.

IV. The Classification of Sponges.

Having thus ascertained the systematic position of the Sponges as a group, we now approach the second part of our work.

Every one will agree that no satisfactory classificatory system of Sponges exists at present. Spongologists are in the habit of approaching this subject with great caution, I may say with diffidence.

It is a remarkable fact that the leading spongologist of the day, my esteemed teacher Prof. F. E. Schulze, in Berlin, has not attempted to work out a classificatory system of Sponges, whilst others have made some desultory efforts in that direction. It is self-evident that the systems established by Bowerbank, O. Schmidt, Gray, and others, which date from a time when virtually nothing was known about Sponges, have now become obsolete. The most successful attempt at establishing a system of Sponges is doubtless that of Vosmaer (1550), who, however, approaches his task with great diffidence; everywhere we meet in his work with "preliminary" classifications. Some geologists, principally Zittel (1635) and Sollas (1455), have classified the Sponges in a rather high-handed manner, establishing subclasses, orders, &c., without regard to details like families and genera. Zittel particularly attached too much importance to the fossil Sponges.

In the groups themselves more satisfactory detail work has recently been done. F. E. Schulze (1369) has worked out the Hexactinellids of the 'Challenger' with results which are as valuable and useful as the material at his disposal was abundant and interesting. Zittel (1626–1629) has in a satisfactory manner dealt with the fossil Sponges belonging to the same group. The Lithistids and Tetractinellids, both fossil and recent, have been carefully investigated by Zittel (1639) and Sollas (1453). I (888) have, with the aid of the works of Häckel (627–629) and Polejaeff (1179) at my disposal, established a system of Calcareous Sponges based on my investigations of the rich Australian Sponge-fauna, which appears fairly satisfactory.

The Monactinellids have been carefully studied by Vosmaer (1545), Ridley (1261), and Ridley and Dendy (1265–1266), and I have myself devoted much labour to their investigation, and have made (870) an attempt at classifying them, which, however, was unsuccessful. The Australian Fauna is exceedingly rich in Monactinellids, and my collection, of over 300 species, has enabled me to work out the classification of some of the groups in detail.

No attempt has hitherto been made to classify the Horny Sponges excepting one, contained in a short paper of Vosmaer (1552), establishing five groups, in accordance with the views previously expressed by myself (868), and based on the result of the researches into the structure of horny sponges by F. E. Schulze (1345, 1348, 1349, 1351) and myself (868). The Australian marine fauna is exceedingly rich in horny sponges, so that I have been enabled to work out their relationships in detail.

If we review the Sponges as a whole, we shall be struck with the great fundamental difference between the Calcareous and all

the other Sponges. Grant (526) was the first to point this out, and he accordingly divided the Sponges into Calcarea and Non-Calcarea. Vosmaer (1550) agrees in this point with Grant and uses his terms. I have also (888) adopted the same view. In this paper I intend to alter the term Non-Calcarea, which is misleading, inasmuch as it might be interpreted as meaning that the group so named consisted of very heterogeneous elements, coinciding with each other only in one, and that a negative character. This is not the case. I divide the Classis Spongiæ accordingly into two *Subclasses*, I. Calcarea, and II. Silicea.

The point of distinction between these two Subclasses is, that all the *Calcarea* have a skeleton composed of spicules consisting chiefly of carbonate of lime. All the other Sponges, which I comprise under the heading *Silicea*, either have a skeleton composed of siliceous spicules or have been derived phylogenetically from siliceous Sponges, and have only recently lost their spicules or replaced them with a horny support. O. Schmidt (1305) and also myself (870) were inclined to think that *some of* the siliceous Sponges had descended from horny ones. I have, however, since abandoned this view (901), and consider that the opposite direction of development, which Vosmaer (1558) advocates, is the correct one.

We have accordingly :—

Classis SPONGIÆ.

Skeleton composed chiefly of carbonate of lime.	Skeleton originally composed of siliceous spicules.
I. Subclassis Calcarea.	II. Subclassis Silicea.

As mentioned above, in the critical introduction to this chapter, I have nothing to add to my system of Calcareous Sponges (888) published some time ago, and I adopt it unchanged in this paper. The Calcarea are a very much smaller group than the Silicea. In this Subclass we only distinguish one Order, the Calcispongiæ (Blainville); whilst the Silicea must be divided into several Orders, and it is here that we meet with the greatest difficulty in ascertaining the true relationship of the different forms. There are no transitions between the two subclasses. In examining the structure of a great number of Sponges belonging to this second group, the subclass Silicea, I found that they can be arranged in three Groups, which will appear as Orders in my system. These are the Hexactinellida, the Chondrospongiæ, and the Cornacuspongiæ. These groups are fairly distinct, and transitional forms connecting them are rare. The Sponges of these Orders are descended from siliceous Sponges, and show the same tendency of development within each group.

In the Hexactinellida we invariably meet with a skeleton composed of triaxial spicules; these are often attached to each other by a siliceous cement which greatly strengthens the structure.

All authors agree that the Hexactinellida form a well-defined group. The remaining Silicea, however, are a very mixed lot, and before Vosmaer, no satisfactory arrangement of them had been arrived

at. The one I propose in this paper, which is similar to that of Vosmaer, is certainly very far from being as perfect as I would like to make it; but I think that at all events it is much more likely to express the relationship of Sponges in a correct manner than any other existing arrangement.

The subclass Silicea minus the order Hexactinellida comprises the Sponges with a skeleton composed of tetraxial spicules (the Tetractinellida and Lithistidæ of Marshall and other authors), the Sponges with monaxial spicules (the Monactinellida of Zittel and other authors), the Sponges with a horny skeleton and without spicules in the supporting skeleton (the Ceraospongiæ or Keratosa of many authors), and, finally, the Sponges without any supporting skeleton at all (the Myxospongiæ of Häckel).

At first sight all these forms appear connected with each other in every direction by transitional forms to such an extent that it seems hopeless to bring order into this chaotic mass. A careful investigation of many forms shows that *all* the familiar groups Tetractinellida, Lithistidæ, Monactinellida, Ceraospongiæ, and Myxospongiæ run into each other at every point. If one, however, for years endeavours to find some constancy in the varying characters of any chaotic mass of this kind, he at last generally arrives at an idea which seems clear enough when once grasped. And then one only wonders how it was that it had not been conceived a long time ago. So it was also in this case. I found that all these Sponges could be very naturally divided into *two* Orders—the above-mentioned Chondrospongiæ and Cornacuspongiæ, the first of which comprises the Lithistids, Tetractinellida, and portions of the Monactinellida, together with most Myxospongiæ; whilst the second contains all the Ceraospongiæ, and the remainder of the Monactinellids and Myxospongiæ.

We find that the ground-substance, the mesodermal intercellular substance or Mesoglœa, as it is variously termed, is more or less hard and cartilage-like in the Chondrospongiæ, and that in these the spicules remain isolated. The spicules are either tetraxon or tylostyles, less frequently styles. The monaxon spicules are monact, thereby indicating their closer affinity with the tetraxou spicules. The necessary toughness is given to these Sponges not by a cementing of the spicules, but by a hardening of the ground-substance. In some the spicules disappear altogether, as in *Oscarella*, which is an askeletous form of *Plakina*, and in *Chondrosia*, which is an askeletous sponge belonging to the *Tethya* group.

In the Cornacuspongiæ, on the other hand, there is no tendency towards a hardening of the ground-substance discernible. The ground-substance remains soft and gelatinous, and the necessary toughness is given to the sponge by the formation of a substance not found in other Sponges, which cements the spicules together. This substance is chemically and physically comparable to silk or horn, and is known as Spongin.

The spongin may become very voluminous and the spicules scarce and small. They may finally disappear altogether, and then

we have Ceraospongiæ before us. Transitional forms between the Cornacuspongiæ with supporting spicules cemented by spongin, and Cornacuspongiæ without spicules in their fibres (horny sponges), are not unfrequent.

One whole subfamily, the Chalininæ, comprising nearly 300 species, is composed of such transitional forms. The supporting spicules met with in the Cornacuspongiæ are invariably monaxon without a swelling at one end. Besides these more or less rod-shaped supporting spicules, we also find in some of the Sponges belonging to this group so-called flesh-spicules—small, irregular curved or complicated elements scattered throughout the Mesoglœa. These occur associated with spicules in the fibrous supporting skeleton and also in those forms which have no spicules in their horny supporting skeleton. To this group also the genera *Halisarca* and *Bayalus* belong, which have no skeleton at all, and appear as askeletous forms of the Aplysillide type. The term Cornacuspongiæ was established by Vosmaer (1550), and used by him in a very similar sense to that in which it is used here. The group Chondrospongiæ, on the other hand, is in the sense given above a new one; it nearly coincides with Vosmaer's group Spiculispongiæ (1550). In a former paper (889) I had retained the group Myxospongiæ, for the sake of convenience, preliminarily only, and agreeing at the time with Sollas (1440) that it was unnatural. The manner in which I have distributed the members of the Myxospongiæ among other groups is in accordance with the view expressed by F. E. Schulze in a letter.

We have accordingly to divide the subclass Silicea into three groups in the following manner:—

Subclassis *SILICEA*, Lendenfeld.

Mesoglœa soft; supporting skeleton often strengthened with siliceous cement. Spicules triaxon.	Mesoglœa hard; toughness achieved by the hardening of the ground-substance. Spicules tetraxon, monaxon, anaxon, or absent; generally corticate.	Mesoglœa soft; supporting skeleton strengthened by spongin cement; or exclusively formed of spongin, with or without foreign bodies. Spicules monaxon, or absent.
2. Ordo HEXACTINELLIDA, O. Schmidt.	3. Ordo CHONDROSPONGIÆ, Lendenfeld.	4. Ordo CORNACUSPONGIÆ, Vosmaer.

Expressed in the usual manner, the class Spongiæ would be accordingly divided into *four* Orders in the following manner:—

Classis **SPONGIÆ**, auctorum.

Cœlentera with branching canal-system, without movable appendages; the organs of which are developed from cells of the mesoglœa. With simple epithelia.

I. Subclassis *CALCAREA*, Grant.

Spongiæ with a skeleton composed of spicules which consist chiefly of carbonate of lime.

1. Ordo CALCISPONGIÆ, Blainville.

The only Order, with the characters of the Subclassis.

II. Subclassis *SILICEA*, Lendenfeld.

Spongiæ with a skeleton composed of siliceous spicules and their descendants with horny aspiculous skeleton and askeletous forms.

2. Ordo HEXACTINELLIDA, O. Schmidt.

Silicea with soft mesoglœa. Supporting skeleton often strengthened with siliceous cement. Spicules triaxon.

3. Ordo CHONDROSPONGIÆ, Lendenfeld.

Silicea in which the toughness is achieved by the mesoglœa or mesodermal ground-substance becoming cartilaginous, whilst the spicules remain isolated. Spicules tetraxon, monaxon (tylostylus), or absent; generally corticate.

4. Ordo CORNACUSPONGIÆ, Vosmaer.

Silicea with soft mesoglœa or mesodermal ground-substance; the supporting skeleton, composed of bundles of monaxonid not tylostyle spicules, is strengthened by spongin, which cements the spicules. These may disappear altogether, and the skeleton is then composed of spongin with or without foreign bodies. The skeleton rarely disappears altogether.

Having thus divided the Class Spongiæ into four Orders, we may proceed to the further division of the Orders into Families.

I. Ordo CALCISPONGIÆ, Blainville.

This Order has been divided by Häckel (627-629) into the well-known three families Ascones, Leucones, and Sycones, with seven genera in each. Poléjaeff (1179) has divided the group into two Suborders and replaced Häckel's genera by the older and wider genera of Grant and others. I (888) have tried to combine Häckel's and Poléjaeff's classifications, and have added three new families to the existing ones.

I have retained Poléjaeff's terms for the two Suborders, but have altered their meaning. In some Calcareous Sponges the whole of the entoderm consists of collar-cells. There are no entodermal pavement-cells in these forms. These constitute my first Suborder Homocœla. In others the collar-cells are found in the ciliated chambers only, while the central gastral cavity is clothed with entodermal pavement-cells. I combine these forms in the Suborder Heterocœla.

To the Homocœla belong besides Häckel's Asconidæ, my families Homodermidæ and Leucopsidæ. I acknowledge Häckel's seven genera of the Asconidæ.

In the Heterocœla, Häckel's families Leuconidæ and Syconidæ together with Carter's Teichonidæ and my family Sylleibidæ are placed.

II. Ordo HEXACTINELLIDA, O. Schmidt.

Schulze (1369) divides the living Hexactinellida into the two Suborders Lyssacina and Dictyonina of Zittel. In the first, the spicules remain isolated or coalesce secondarily in an irregular manner; in the second, the main spicules coalesce to begin with in a very regular manner, so as to form a continuous scaffolding. In the first suborder Lyssacina, the families Euplectellidæ, Gray, Asconematidæ, F. E. Schulze, Rossellidæ, F. E. Schulze, and Hyalonematidæ, Gray, are placed. The second suborder, Dictyonina, comprises the families Farreidæ, Gray, Euretidæ, F. E. Schulze, Melittionidæ, Zittel, Coscinoporidæ, Zittel, and Meandrospongidæ, Zittel. To these the fossil families Ventriculitidæ, Staurodermidæ, Callodictyonidæ, Cœloptychidæ, Receptaculitidæ, and Monakidæ must be added.

In the classificatory scheme below, Schulze's diagnoses are translated.

III. Ordo CHONDROSPONGIÆ, Lendenfeld.

As mentioned above, this Order coincides nearly with Vosmaer's (1550) order Spiculispongiæ. I divide it into the two groups, Tetraxonia and Monaxonia. The former comprises the Sponges with tetraxon spicules, Tetractinellids and Lithistids; and the latter those forms which have monaxon spicules, or which have no spicules at all.

Sollas (1453) divides the Tetraxonia into two groups:—Choristida, Sollas, without lithistid sclerites; and Lithistida, Zittel, with lithistid sclerites. In the first group the families Plakinidæ, Pachastrellidæ, Corticidæ, Tetillidæ, Theneidæ, Stellettidæ, and Geodinæ are distinguished.

Vosmaer (1550) divides the Lithistidæ, in accordance with Zittel (1639) and O. Schmidt (1306, 1322), into the families Rhizomorinidæ, Megamorinidæ, Anomacladinidæ, Tetracladinidæ.

The Monaxonia comprise the families Suberitidæ, Spirastrellidæ, Tethydæ, and Chondrosidæ. The Clavulina and portion of the Oligosilicina of Vosmaer.

IV. Ordo CORNACUSPONGIÆ.

I divide the Cornacuspongiæ into the two suborders Halichondrina with, and Ceraospongiæ without, proper spicules in the supporting skeleton.

The Halichondrina comprise the three families Homorhaphidæ, Heterorhaphidæ, and Desmacidonidæ of Ridley and Dendy (1265, 1266).

The Ceraospongiæ are divided by me into two groups—Macrocameræ with large, and Microcameræ with small, ciliated chambers. To the former belong the families Aplysillidæ and Spongelidæ, and to the latter the Spongidæ, Aplysinidæ, and Hircinidæ.

After this general view of the Classification of Sponges, I shall proceed to give a "system" of Sponges down to subfamilies, mentioning the principal genera in each group.

Classis SPONGIÆ, auctorum.

Cœlenterata with branching canal-system, the organs of which are developed from cells of the mesoglœa or primary mesoderm. With simple epithelia, with entodermal collar-cells, and without movable appendages and enidoblasts.

I. Subclassis *CALCAREA*, Grant.

Sponges with a skeleton composed of calcareous spicules.

I. Ordo CALCISPONGIÆ, Blainville.

The only order, with the characters of the subclass.

1. Subordo HOMOCŒLA, Poléjaeff, emend.

The entodermal epithelium consists exclusively of collar-cells.

1. Familia ASCONIDÆ, Häckel.

Simple sac-shaped gastral cavity with smooth surface.

Leucosolenia, Poléjaeff, *Ascetta*, *Ascissa*, *Ascilla*, *Ascaltis*, *Ascortis*, *Asculmis*, *Ascandra*, Häckel.

2. Familia HOMODERMIDÆ, Lendenfeld.

The gastral cavity forms cæcal outgrowths, which resemble the tubes of Syconidæ.

Ascaltis canariensis, Häckel, *Ascaltis lamarckii*, Häckel, and *Homoderma sycandra*, Lendenfeld.

3. Familia LEUCOPSIDÆ, Lendenfeld.

A colony of Ascon-persons which are imbedded in the thick mesoglœa. There are narrow inhalant pores and wider exhalant ones. The latter lead into a pseudogaster.

Leucopsis, Lendenfeld, and some species of *Pseudonardorus-forms*.

II. Subordo HETEROCŒLA, Poléjaeff, emend.

The entodermal epithelium is differentiated into collar-cells, which are found in the walls of the ciliated chambers only, and into flat pavement-cells, which clothe the walls of the exhalant canals and gastral cavity.

4. Familia SYCONIDÆ, Häckel.

With regular, radially disposed cylindrical ciliated chambers, which open direct into the sac-shaped gastral cavity.

1. Subfamilia *Syconinæ*, Lendenfeld.

The unbranched ciliated chambers remain isolated in their distal part.

Sycon, Poléjaeff, the subgenera of Häckel's Syconidæ which terminate with the syllable "*aga*." I divide this subfamily according to Häckel's scheme into the seven genera *Sycetta*, *Sycissa*, *Sycilla*, *Sycaltis*, *Sycortis*, *Syculmis*, and *Sycandra*.

2. Subfamilia *Uteinæ*, Lendenfeld.

With simple unbranched ciliated chambers, the distal ends of which are imbedded in a continuous cortex. *Grantessa*, Lendenfeld, *Ute*, Polejaeff, and *Amphoriscus*, Poléjaeff, and those subgenera of the Syconidæ in Häckel's system which terminate with the syllable "*usa*."

3. Subfamilia *Grantinæ*, Lendenfeld.

With branched ciliated chambers.
Grantia, *Heteropegma*, and *Anamixilla*, Poléjaeff.

5. Familia Sylleibidæ, Lendenfeld.

With complicated exhalant canals, leading from the cylindrical ciliated chambers into the gastral cavity.

1. Subfamilia *Vosmaerinæ*, Lendenfeld.

The ciliated chambers are radially situated, and form a regularly cylindrical zone. They are connected with the gastral cavity by a network of anastomosing exhalant canals.
Vosmaeria, Lendenfeld, and *Leucetta*, Poléjaeff.

2. Subfamilia *Polejnæ*, Lendenfeld.

The ciliated chambers form a much-folded layer. The exhalant canals are wide, and do not anastomose to form a reticulation.
The genera *Polejna*, Lendenfeld, and *Leucilla*, Poléjaeff, constitute this group.

6. Familia Leuconidæ, Häckel.

Heterocœla with ramified canal-system and spherical ciliated chambers.
Leucetta, *Leucissa*, *Leucaltis*, *Leucortis*, *Leuculmis*, and *Leucandra*, Häckel. *Leuconia*, auctorum, and *Leuconia* and *Pericharax*, Poléjaeff.

7. Familia Teichonidæ, Carter.

Heterocœla without gastral cavity. The inhalant pores are situated on the one, and the exhalant on the other side of the lamellar sponge; with spherical ciliated chambers.
Teichonella, Carter, and *Eilhardia*, Poléjaeff.

II. Subclassis *SILICEA*, nov.

Sponges with a skeleton composed of siliceous spicules and their derivatives; possessing a horny skeleton or no skeleton at all, but never supported by calcareous spicules.
Comprises the Non-Calcarea of Grant and other authors.

I. Ordo HEXACTINELLIDA, O. Schmidt.

Silicea with triaxon spicules and soft mesoglœa. Strengthened by siliceous cement, generally joining the spicules.

I. Subordo Lyssacina, Zittel.

The spicules remain isolated or are subsequently cemented together irregularly.

i. Tribus *Hexasterophora*, F. E. Schulze.

Hexaster always found in the mesoglœa; chambers distinct, thimble-shaped.

1. Familia Euplectellidæ, F. E. Schulze.

Thin-walled tubes or sacs with sword-shaped hexact hypodermalia, the centripetal rays of which are the longest.

1. Subfamilia *Euplectellinæ*, F. E. Schulze.

Tubular, with terminal sieve-plates. The wall regularly perforated. To the centrifugal ray of each hypodermal a floricome is attached.

Euplectella, Owen, and *Regadrella*, O. Schmidt.

2. Subfamilia *Holascinæ*, F. E. Schulze.

Tubular, wall without perforations, without superficial floricomes.

Holascus and *Malacosaccus* of F. E. Schulze.

3. Subfamilia *Taegerinæ*, F. E. Schulze.

Tubular or sac-shaped, wall irregularly perforated. Principalia partially cemented, forming an irregular network. To the distal ray of each hypodermal sword-shaped hexact a floricome is attached.

Taegeria and *Walteria* of F. E. Schulze.

2. Familia Asconematidæ, F. E. Schulze.

Pentact or hexact pinnulæ in the dermal and gastral surfaces. Hypodermalia and hypogastralia pentact. Discohexaster in the interior.

1. Subfamilia *Asconematinæ*, F. E. Schulze.

Sessile, sac-shaped, or tubular, with thin soft wall.

Asconema, Sav. Kent, and *Aulascus*, F. E. Schulze.

2. Subfamilia *Sympagellinæ*, O. Schmidt.

Pedunculate, cup-shaped. Principalia hexact and diact. Discohexaster in the interior.

Sympagella, O. Schmidt, *Polyrhabdus*, F. E. Schulze, and *Balanites*, F. E. Schulze.

3. Subfamilia *Caulophacinæ*, F. E. Schulze.

Mushroom-shaped, with long cylindrical hollow peduncle.

Caulophacus and *Trachycaulus* of F. E. Schulze.

3. Familia Rossellidæ, F. E. Schulze.

The dermalia have no centripetal ray.

Lanuginella, O. Schmidt; *Polylophus*, F. E. Schulze; *Rossella*, Carter; *Acanthascus*, *Bathydorus*, *Rhabdocalyptus*, *Crateromorpha*, *Aulochone*, *Caulocalyx*, and *Aulocalyx*, F. E. Schulze.

ii. Tribus *Amphidiscophora*, F. E. Schulze.

Amphidiscs in the limiting membranes. Hexaster absent in the interior. A basal tuft is always present. The ciliated chambers appear as somewhat irregular sac-shaped extensions of the membrana reticularis.

4. Familia Hyalonematidæ, Gray.

Numerous pentact pinnulæ in the dermal and gastral surfaces.

1. Subfamilia *Hyalonematinæ*, F. E. Schulze.

Calyculate, with a well defined oscula-area on the upper surface.

Hyalonema, Gray; *Stylocalyx*, F. E. Schulze; *Pheronema*, Leidy; and *Poliopogon*, Wyville Thomson.

2. Subfamilia *Semperellinæ*, F. E. Schulze.

Without gastral cavity and terminal oscula-area, with root-tuft.

Semperella, Gray.

To this Subordo the fossil families Receptaculitidæ and Monakidæ belong.

ii. Subordo Dictyonina, Zittel.

The parenchymal hexacts early coalesce in a regular manner, so as to form a firm skeleton.

i. Tribus *Uncinataria*, F. E. Schulze.

With uncinates.

i. Subtribus *Clavularia*, F. E. Schulze.

With radially situated clavulæ.

1. Familia Farreidæ, F. E. Schulze.

The skeleton forms a single layer; from the joining points conical extensions arise, in a direction vertical to the surface of the network.

Farrea, Bowerbank.

2. Subtribus *Scopularia*, F. E. Schulze.

With radially situated scopulæ.

2. Familia Euretidæ, F. E. Schulze.

Branched and anastomosing tubes. The skeleton-net forms several layers.

Eurete, Carter; *Periphragella*, Marshall; and *Lefroyella*, Wyville Thomson.

3. Familia Melittionidæ, Zittel.

Forms branched tubes or calyculate structures. Skeleton honeycombed. Cavities traversed by the reticular membrane. The gastral skeleton without scopulæ.

Aphrocallistes, Gray.

4. Familia Coscinoporidæ, Zittel.

The wall of the calyculate or expanded sponge is traversed by funnel-shaped straight canals, which open alternately on the one or the other surface. Covered only by the perforated limiting membrane.

Chonelasma, F. E. Schulze; and the fossil genera *Leptophragma*, Zittel, *Guettardia*, Michelin, and *Coscinopora*, Goldfuss.

5. Familia Tretodictyidæ, F. E. Schulze.

With irregular inhalant and exhalant canals, which do not traverse the body transversely, but pass the dense dictyonal skeleton obliquely or longitudinally.

Tretodictyum, F. E. Schulze; *Euriplegma*, F. E. Schulze; *Cyrtaulon*, F. E. Schulze; *Fieldingia*, Sav. Kent; and *Scleracthamnus*, Marshall.

ii. Tribus *Inermia*, F. E. Schulze.

Without uncinates and scopulæ.

6. Familia Meandrospongidæ, Zittel.

The body consists of winding tubes of uniform width. The interstices of the tubes form a vestibule space.

Dactylocalyx, Stutchbury; *Scleroplegma*, O. Schmidt; *Margaritella*, O. Schmidt; *Myliusia*, Gray; and *Aulocystis*, F. E. Schulze; and the fossil genera:—*Placoscyphia*, Reuss; *Tremabolites*, Zittel; *Etheridgia*, Tate; *Cystispongia*, Roemer; *Toulminia*, Zittel; and *Camerospongia*, d'Orb.

To this Subordo belong the fossil families Ventriculitidæ, Staurodermidæ, Callodictyonidæ, and Cœloptychidæ.

II. Ordo CHONDROSPONGIÆ, nov.

Silicea in which the toughness is caused by the mesoglœa or mesodermal ground-substance becoming cartilaginous, whilst the spicules remain isolated. Spicules tetraxon, monaxon (tylostylus or stylus), or absent. With spherical ciliated chambers. Sponge generally corticate.

Comprises the Spiculispongiæ of Vosmaer, with the exception of the genus *Halisarca*, Vosmaer.

i. Subordo Tetraxonia, Vosmaer.

With tetraxon spicules.

I. Group Lithistida, Zittel.

Body stony, with a central gastral cavity or numerous vertical tubes. Spicules more or less clearly tetraxon, often branched. Besides these, sometimes monaxon spicules and flesh-spicules. The skeleton-spicules are interwoven so as to form a dense skeleton.

1. Familia Rhizomorinidæ, Zittel.

Spicules irregularly branched; form irregular fibres, or are loosely interwoven. Forked anchors always present.

Arabescula, Carter; *Corallistes*, Schmidt; *Heterophymia*, Pomel; *Seliscothon*, Zittel; *MacAndrewia*, Gray; *Azorica*, Carter; *Leiodermatium*, Schmidt; and the fossil genera:—*Cnemidiastrum*, *Corallidium*, *Hyalotragos*, *Pyrgochonia*, *Discostroma*, *Leiodorella*, *Epistomella*, *Platychonia*, *Bolidium*, *Astrobolia*, and *Chonella* of Zittel; *Plococonia*, Pomel; *Chenendopora*, Lamouroux; *Verruculina*, Zittel; *Amphithelion*, Zittel; *Stychophyma*, Pomel; *Allomera*, Pomel; *Pleuromera*, Pomel; *Perimera*, Pomel; *Meta*, Pomel; *Marisca*, Pomel; *Pomelia*, Zittel; *Jereica*, Zittel; *Cœlocorypha*, Zittel; *Scytalia*, Zittel; *Stachyspongia*, Zittel; *Pachinion*, Zittel.

2. Familia Anomocladinidæ, Zittel.

Spicules rod-shaped with terminal tufts of branches. The approximating ends of the spicules coalesce and form knots. In this way a regular triaxial network is formed.

Vetulina, Schmidt; and the fossil genera *Mastosia*, *Cylindrophyma*, *Melonella*, and *Protachilleum*, Zittel, and *Palæomanon* and *Astylospongia*, Roemer.

3. Familia Tetracladinidæ, Zittel.

Spicules tetractinellid with terminal branches.

Theonella, Gray; *Rhacodiscula*, Zittel; *Discodermia*, Bocage; *Kaliapsis*, Bowerbank; *Collectella*, Schmidt; *Collinella*, Schmidt; and the fossil genera:—*Aulocopium*, Oswald; *Phymatella*, *Aulaxinia*, *Callopegma*, and *Trachysycon*, Zittel; *Siphonia*, Parkinson; *Hallirhoa*, *Jerea*, Lamouroux; *Marginospongia*, d'Orbigny; *Nelumbia*, Pomel; *Polyjerea*, Fromentel; *Astrocladia*, Zittel; *Bolospongia*, Hinde; *Thecosiphonia*, Zittel; *Calymmatina*, Zittel; *Turonia*, Michelin; *Kalpinella*, *Thamnospongia*, and *Pholidocladia*, Hinde; *Ragadinia*, Zittel; *Plinthosella*, Zittel; *Spongodiscus*, Zittel; *Phymaplectia*, Hinde; *Rhopalospongia*, Hinde.

To this Subordo also the fossil family Megamorinidæ belongs.

II. Group Choristida, Sollas.

With tetraxon spicules of regular shape.

i. Tribus *Tetradina*, Sollas.

The chief spicules are tetract, with equal rays and candelabras.

i. Subtribus *Microcameræ*, nov.

With small chambers.

4. Familia Corticidæ, Vosmaer.

With candelabras.
Corticium, Schmidt, and *Thrombus*, Sollas.

5. Familia Pachastrellidæ, Sollas.

With simple tetracts, irregularly scattered.
Pachastrella, Schmidt, *Battersbya*, Bowerbank, and *Dercitus*, Gray.

ii. Subtribus *Macrocameræ*, nov.

With large chambers.

6. Familia Plakinidæ, F. E. Schulze.

With scattered diact, triact, and tetract spicules.
Plakina, *Plakinastrella*, and *Plakortis*, F. E. Schulze, and *Eupalax*, Sollas.

7. Familia Oscarellidæ, Lendenfeld.

Without spicules.
Oscarella, Vosmaer.

ii. Tribus *Trianina*, Sollas.

The centres of the tetraxon spicules with one differentiated ray lie in the surface, in which the equal rays extend tangentially.

8. Familia Geodidæ, Sollas.

A cortex of globate spicules. Chambers small, with small outlets.
Erylus, Gray; *Caminus*, Schmidt; *Cydonium*, Müller; *Synops*, Vosmaer; *Isops*, Sollas; *Geodia*, Lamarck; and *Geodissa*, Lendenfeld.

9. Familia Stellettidæ, Sollas.

With stellate flesh-spicules usually in the cortex.

1. Subfamilia *Psammasterina*, Sollas.

With stellates and spined rods.
Psammastra, Sollas.

2. Subfamilia *Stryphnina*, Sollas.

With stellates and amphiastrellæ.
Stryphnus, Sollas.

3. Subfamilia *Sanidasterina*, Sollas.

With stellate and sanidaster (?) spicules.
Tribrachium, Weltner, and *Tethyopsis*, Stewart.

4. Subfamilia *Stellettina*, Sollas.

With two kinds of stellate flesh-spicules.
Antrastra, *Dragmastra*, Sollas; *Stelletta*, Schmidt.

5. Subfamilia *Homasterina*, Sollas.

With one kind of stellate flesh-spicules.
Myriastra, Sollas; *Asterella*, Sollas; *Pilochrata*, Sollas.

10. Familia Theneidæ, Sollas.

With large outlets to the ciliated chambers, and spirastrellid spicules.

Thenea, Gray (*Tisiphonia*, Wyville Thomson, *Dorvillia*, Sav. Kent, *Wyville-Thomsonia*, Wright); *Normania*, *Vulcanella*, and *Characella*, Sollas.

11. Familia Tetillidæ, Sollas.

With flesh-spicules which are hamate, spiral, or rod-shaped.

Spiretta, Lendenfeld; *Tetilla*, Schmidt; *Craniella*, Schmidt; *Chrotella*, Sollas; *Papirula*, Schmidt; *Thalassomora*, Lendenfeld.

12. Familia Tethyopsillidæ, nov.

Spherical sponges supported by dense masses of large radial monaxonid spicules. A few tetraxonid grapnels are inserted in the surface.

Tethyopsilla, Lendenfeld, and *Protoleia*, Dendy and Ridley.

II. Subordo Monaxonida.

III. Group Clavulina, Vosmaer, emend.

With monaxonid spicules or without supporting skeleton.

Supporting spicules tylostyle, usually radially situated. (Includes the *Pseudotetraxonia*, Vosmaer.)

1. Familia Tethydæ, Vosmaer.

More or less spherical sponges, with regular subdermal cavities between the thick distally extending radial bundles of spicules.

1. Subfamilia *Tethynæ*, nov.

With stellate flesh-spicules.

Tethya, Lamarck; *Tuberella*, Keller (*Tethiophæna*, Schmidt); *Tethiosphæra*, Lendenfeld; *Mastigophora*, Lendenfeld; *Thalassodactylus*, Lendenfeld.

2. Subfamilia *Tethiopsamminæ*, nov.

With a sand cortex.

Tethiopsamma, Lendenfeld, MS.

3. Subfamilia *Tethyorhaphinæ*, nov.

With rod-shaped flesh-spicules, without stellates.

Tethyorhaphis, Lendenfeld.

4. Subfamilia *Tethyamatinæ*, nov.

With hamate flesh-spicules (sigmata) without stellates.

Tethyamata, Lendenfeld.

2. Familia Sollasellidæ, Lendenfeld.

Digitate forms with radiating spicule-bundles, and distinct ecto- and endochonæ.

Sollasella, Lendenfeld.

3. Familia Spirastrellidæ, Ridley and Dendy.

With spirastrellid flesh-spicules.

Spirastrella, Ridley; *Raphyrus*, Bowerbank; *Papillina*, Schmidt; *Cheirella*, Lendenfeld; *Axos*, Gray; and *Suberocorona*, Lendenfeld. Coincides with the family Cheirellidæ, Lendenfeld.

4. Familia Suberamatidæ, nov.

With hamate flesh-spicules (sigmata).

Suberamata, Lendenfeld.

5. Familia Suberitidæ, Vosmaer, emend.

Without flesh-spicules.

Suberitella, Lendenfeld; *Suberites*, Nardo; *Suberopetros*, Lendenfeld; *Plectodendron*, Lendenfeld; *Polymastia*, Bowerbank; *Trichostemma*, M. Sars; *Tentorium*, Vosmaer (*Thecaphora*, O. Schmidt); *Stylocordyle*, Wyv. Thomson; *Quasillina*, Norman; *Cliona*, Grant; and *Poterion*, Schlegel.

iv. Subordo Oligosilicina, Lendenfeld.

Without supporting skeleton. Flesh-spicules, when present, anaxon polyactinellid. Chambers small, with narrow outlet.

1. Familia Chondrillidæ, Lendenfeld.

With polyactinellid flesh-spicules. Comprises the genus *Chondrilla*, O. Schmidt.

2. Familia Chondrosidæ, Lendenfeld.

Without flesh-spicules. Comprises the genus *Chondrosia*, Nardo.

III. Ordo CORNACUSPONGIÆ, Vosmaer, emend.

Silicea with soft mesoglœa, or mesodermal ground-substance. The supporting skeleton is composed of bundles of monaxonids, which are never tylostyle spicules. The skeleton is strengthened by spongin, which cements the spicules. These may disappear altogether, and the skeleton is then composed of spongin, with or without foreign bodies. Exceptionally, also, this horny skeleton disappears. The ciliated chambers have large outlets.

i. Subordo Halichondrina, Vosmaer.

With siliceous spicules in the supporting skeleton.

1. Familia Spongillidæ, Carter.

Freshwater sponges with gemmulæ.

Spongilla, Lamarck; *Ephydatia*, Lamouroux; *Tubella*, Carter;

Uruguaya, Carter; *Parmula*, Carter; *Meyenia*, Bowerbank; *Heteromeyenia*, Potts; *Lubomirskya*, Dybovsky; *Lessepsia*, Keller; *Potamolepis*, Marshall.

2. Familia Homorhaphidæ, Ridley and Dendy.

Megasclera oxea or strongyla; no differentiated microsclera except toxia. Marine sponges without gemmulæ.

1. Subfamilia *Renierinæ*, auct.

Spicules never completely enveloped in horny fibre.

Halichondria, Fleming; *Petrosia*, Vosmaer, =*Schmidtia* Balsamo Crivelli; *Reniera*, Nardo.

2. Subfamilia *Chalininæ*, Ridley and Dendy.

A considerable amount of spongin present, forming distinct horny fibres, in which spicules are contained.

1. Group *Chalinorhaphinæ*, Lendenfeld.

With abundant gigantic spicules axially situated.

Chalinorhaphis, Lendenfeld.

2. Group *Hoplochalininæ*, Lendenfeld.

With abundant gigantic spicules obliquely situated, and protruding beyond the fibre-surface.

Hoplochalina, Lendenfeld.

3. Group *Cacochalininæ*, Lendenfeld.

Irregular forms with slender spicules.

Cacochalina, Schmidt; *Cladochalina*, Lendenfeld; *Chalinopora*, Lendenfeld; *Chalinella*, Lendenfeld; *Chalinopsis*, Schmidt.

4. Group *Pachychalininæ*, Lendenfeld.

Irregular, digitate, lamellar forms with stout spicules, oxystrongylus.

Chalinissa, Lendenfeld; *Pachychalina*, Schmidt; and *Ceraochalina*, Lendenfeld.

5. Group *Plakochalininæ*, Lendenfeld.

Frondose, lamellar forms with stout spicules.

Plakochalina, *Euplakella*, and *Antherochalina*, Lendenfeld; *Cribrochalina*, Schmidt; *Tragosia*, Gray; *Platychalina*, Ehlers.

6. Group *Siphonochalininæ*, Lendenfeld.

Tubular, pseudogaster with stout spicules.

Spinosella, Vosmaer; *Siphonochalina*, Schmidt; *Tuba*, Duchassaing and Michelotti; *Sclerochalina*, Ridley; *Toxochalina*, Ridley; *Phylosiphonia*, Lendenfeld; *Tubulodigitus*, Carter; *Patulascula*, Carter; and *Siphonella*, Lendenfeld.

7. Group *Arenochalininæ*, Lendenfeld.

With spicules in the connecting and sand in the main fibres.

Arenochalina, Lendenfeld.

8. Group *Euchalininæ*, Lendenfeld.

Slender, regularly digitate forms with a fine-meshed network and slender spicules.

Chalina, auctorum, and *Dactylochalina*, *Euchalina*, *Euchalinopsis*, and *Chalinodendron*, Lendenfeld.

3. Familia Heterorhaphidæ, Ridley and Dendy.

Megasclera of various forms; microsclera commonly present, but never chelæ. Marine sponges, without gemmulæ.

1. Subfamilia *Phlœodictyinæ*, Carter.

Sponge divisible into body and fistulæ, with a strong spicular rind. Megasclera oxea or strongyla; microsclera (when present) sigmata.

Rhizochalina, Schmidt; *Oceanapia*, Norman.

2. Subfamilia *Gelliinæ*, Ridley and Dendy.

Megasclera oxea or strongyla. Microsclera always present, viz. sigmata. No rind or fistulæ.

Gellius, Gray; *Gelliodes*, Ridley.

3. Subfamilia *Tedaniinæ*, Ridley and Dendy.

Megasclera of two forms: monactinal, styli, forming the main skeleton; and diactinal, tylota. Microsclera long, hair-like trichites.

Tedania, Gray; *Trachytedania*, Ridley.

4. Subfamilia *Desmacellinæ*, Ridley and Dendy.

Megasclera styli to tylostyli. Microsclera sigmata or toxia, or both.

Desmacella, Schmidt.

5. Subfamilia *Hamacanthinæ*, Ridley and Dendy.

Megasclera oxea or styli; microsclera diankistra, to which others may be added.

Hamacantha, Gray; *Vomerula*, Schmidt.

4. Familia Desmacidonidæ, Vosmaer, auct.

Megasclera of various forms. Microsclera chelæ, to which others may be added.

1. Subfamilia *Esperellinæ*, Ridley and Dendy.

Fibre not echinated by laterally projecting spicules.

Esperia, Nardo; *Esperella*, Vosmaer; *Esperiopsis*, Carter; *Cladorhiza*, Sars; *Axoniderma*, Ridley and Dendy; *Chondrocladia*, Wyv. Thomson; *Desmacidon*, Bowerbank; *Homœodictya*, *Artemisina*, Vosmaer; *Phelloderma*, Ridley and Dendy; *Sideroderma*, Ridley and Dendy; *Iophon*, Gray; *Amphilectus*, Vosmaer; *Melonanchora*, Carter; *Guitarra*, Carter.

2. Subfamilia *Ectyoninæ*, Ridley and Dendy.

Fibre echinated by laterally projecting spicules.

Myxilla, Schmidt; *Clathria*, Schmidt; *Rhaphidophlus*, Ehlers; *Plumohalichondria*, Carter; *Acarnus*, Gray; *Echinoclathria*, Carter; *Clathrissa*, Lendenfeld; *Thalassodendron*, Lendenfeld; *Ceraospina*, Lendenfeld.

5. Familia Axinellidæ, auct.

With large subdermal cavities. Skeleton non-reticulate, consisting of ascending axes of fibre, from which arise subsidiary fibres radiating to the surface pervading the subdermal cavity. Fibres plumose. Megasclera chiefly styli, to which oxea and strongyla may be added. Microsclera rarely present, never chelæ.

Dendropsis, Ridley and Dendy; *Thrinacophora*, Ridley; *Hymeniacidon*, Bowerbank; *Phakellia*, Bowerbank; *Ciocalypta*, Bowerbank; *Acanthella*, Schmidt; *Axinella*, Schmidt; *Raspailia*, Nardo; *Spirophora*, Lendenfeld.

II. Suborder Keratosa, Bowerbank, emend.

Silicea with a supporting skeleton composed of spongin; fibre with or without foreign bodies, but always without proper spicules. Flesh-spicules may be present. Exceptionally, there is no skeleton at all.

i. Tribus *Microcameræ*, Lendenfeld.

With small spherical ciliated chambers and opaque ground-substance.

1. Familia Spongidæ, F. E. Schulze.

With narrow axial thread in the horny fibres, and without filaments.

1. Subfamilia *Auleninæ*, Lendenfeld.

Reticulate sponges with vestibules, without flesh-spicules.

Halme, Aphroditella, Halmopsis, and *Aulena*, Lendenfeld; *Psammaclema*, Marshall.

2. Subfamilia *Chalinopsillinæ*, Lendenfeld.

When dry of light yellow colour, digitate, lamellar, more or less flower-shaped, imitating very closely Chalininæ, from which they appear only recently to have developed. Without flesh-spicules, with smooth surface.

Chalinopsilla and *Antheroplax*, Lendenfeld; *Dactylia*, Carter.

3. Subfamilia *Sponginæ*, Lendenfeld.

Massive, when dry dark brown, with conulated or granulated surface. Vestibules, when present, belong exclusively to the *inhalant* system. Without flesh-spicules.

Euspongia, Bronn; *Cacospongia*, Schmidt; *Hippospongia*, F. E.

Schulze; *Coscinoderma*, Carter; *Spongodendron*, Lendenfeld; and many of the species of the genus *Spongia*, auctorum.

4. Subfamilia *Spongissinæ*, Lendenfeld.

With flesh-spicules.
Spongissa, Lendenfeld, MS.

2. Familia Aplysinidæ, Lendenfeld.

The skeleton is composed of spongin-tubes, the walls of which are thinner than the diameter of the lumen, which is filled with pith.

1. Subfamilia *Aplysininæ*.

Without flesh-spicules.
Luffaria, Duchassaing and Michelotti; *Aplysina*, Nardo; *Luffarella*, Lendenfeld, MS.; *Dendrospongia*, Hyatt.

2. Subfamilia *Aplysissinæ*, Lendenfeld.

With flesh-spicules.
Aplysissa, Lendenfeld, MS.

3. Familia Hircinidæ, Lendenfeld.

With narrow axial canal in the fibres, and filaments in the ground-substance.

1. Subfamilia *Hircininæ*, Lendenfeld.

Without proper spicules.
Hircinia, Nardo; *Hircinopsis*, *Nodosina*, *Aphrotriche*, and *Styphlos*, Lendenfeld, MS.; *Stematonemia*, Bowerbank; *Filifera*, Lieberkühn; *Sarcatragus*, Schmidt; and *Polytherses*, Duchassaing and Michelotti.

2. Subfamilia *Hircinissinæ*, Lendenfeld.

With proper spicules.

1. Group *Chalinocinia*, nov.

With proper spicules in the connecting fibres.
Chalinocinia, Lendenfeld.

2. Group *Hircinissa*, nov.

Without proper spicules in the fibres; with flesh-spicules.
Hircinissa, Lendenfeld, MS.

ii. Tribus *Macrocameræ*, Lendenfeld.

With large sac-shaped ciliated chambers, and soft, transparent ground-substance.

4. Familia Spongelidæ, Lendenfeld.

The horny fibres contain slender axial thread and form a reticulated skeleton.

1. Subfamilia *Spongelinæ*, Lendenfeld.

Without flesh-spicules. The skeleton consists of distinct horny fibre containing a varying amount of foreign matter.

Spongelia, Nardo; *Dysidea*, Johnston; and *Reteplax*, Lendenfeld, MS.

2. Subfamilia *Psamm· inæ*, nov.

The skeleton consists of foreign bodies cemented by spongin, which, however, is not distinctly visible; without flesh-spicules.

Psammapemma, Marshall; *Psammella*, Lendenfeld, MS.; and *Holopsamma*, Carter.

3. Subfamilia *Spongelissinæ*, Lendenfeld.

The skeleton is composed of distinct horny fibres containing foreign bodies. With flesh-spicules.

Dysideissa, Lendenfeld, MS.

4. Subfamilia *Psammopessinæ*, nov.

The skeleton consists of cemented foreign bodies without distinct horny fibres. With flesh-spicules.

Psammopessa, Lendenfeld, MS.; *Phoriospongia*, Marshall; and *Haastia*, Lendenfeld, MS.

5. Familia Aplysillidæ, Lendenfeld.

The skeleton consists of spongin-tubes ramified in a dendritic fashion and filled with pith.

1. Subfamilia *Aplysillinæ*, Lendenfeld.

Cells are found in the pith of the fibres only.

Darwinella, Fritz Müller; *Aplysilla*, F. E. Schulze; *Verongia*, Bowerbank; and *Dendrilla*, Lendenfeld.

2. Subfamilia *Ianthellinæ*, nov.

Cells are found in the spongin-sheath of the fibre.

Ianthella, Gray.

6. Familia Halisarcidæ, Vosmaer.

Without skeleton.

Halisarca, Schmidt, and *Bajalus*, Lendenfeld.

V. Key to the Recent Families of Sponges.

0.	Skeleton calcareous	1.
	No calcareous skeleton	(2.)
1.	Entoderm consists exclusively of collar-cells	3.
	Entoderm consists of collar- and pavement-cells	(4.)
3.	Mesoderm thin, gastral cavity irregular	1. *Asconidæ*.
	Mesoderm thin, radial cylindrical chambers	2. *Homodermidæ*.
	Mesoderm thick, irregular chambers	3. *Leucopsidæ*.

(4.)	With cylindrical chambers	5.	
	With spherical chambers	(6.)	
5.	Chambers radial, opening direct into gastral cavity	4.	*Syconidæ.*
	Chambers opening into exhalant canals which lead into the gastral cavity	5.	*Sylleibidæ.*
(6.)	Exhalants lead into oscular tubes	6.	*Leuconidæ.*
	Exhalants open direct on one side of the lamellar sponge; inhalant pores on the other side exclusively	7.	*Teichonidæ.*

(2.)	With hexact spicules and thimble-shaped chambers	7.	
	Without hexact spicules, with sac-shaped or spherical chambers	(8.)	
7.	The spicules remain isolated or partly coalesce afterwards irregularly	9.	
	The supporting spicules early coalesce in a regular Dictyonid manner	(10.)	
9.	Hexaster in the interior	11.	
	No hexasters, but amphidiscs	(12.)	
11.	Hypodermalia hexact sword-shaped, with centripetal radial ray longest; no pinnulæ	8.	*Euplectellidæ.*
	Pinnulæ in the gastral and dermal surfaces	9.	*Asconematidæ.*
	Dermalia without centripetal ray; no pinnulæ	10.	*Rossellidæ.*

(12.)	With numerous pinnulæ	11.	*Hyalonematidæ.*

(10.)	With uncinates	13.	
	Without uncinates	(14.)	
13.	With radially situated clavulæ	12.	*Farreidæ.*
	With radially situated scopulæ	15.	
15.	Branched and anastomosing tubes; the skeleton-net forms several layers	13.	*Euretidæ.*
	Branching tubular or calyculate, honeycombed; cavities traversed by reticular membrane	14.	*Melittionidæ.*
	Calyculate or expanded, traversed transversely by funnel-shaped canals opening alternately on one or other surface	15.	*Coscinoporidæ.*
	Canals irregular, traversing the dense dictyonal skeleton obliquely or longitudinally	16.	*Tetrodictyidæ.*

(14.)	Meandrically winding tubes	17.	*Meandrospongidæ.*

(8.)	With cartilaginous ground-substance and spherical chambers. Spicules polyact, tetract, lithistid, tylostylote, or stylote, never cemented with spongin. Askeletous forms with spherical chambers	16.	
	With soft ground-substance, spherical or sac-shaped chambers. Spicules monaxon, never tylostylote, cemented with spongin. Or skeleton composed of horny fibre without proper spicules. Askeletous forms with sac-shaped chambers	(17.)	

16.	With lithistid irregular tetraxon spicules	18.
	With tetraxon spicules of irregular shape; askeletous forms with large chambers, which have large outlets	(19.)
	With monaxon tylostylote spicules	(20.)
	Without supporting spicules; flesh-spicules when present polyact, with small chambers which have narrow outlets	(21.)
18.	Spicules quite irregular	18. *Rhizomorinidæ.*
	Spicules rod-shaped, with terminal tufts of branches	19. *Anomocladinidæ.*
	Spicules tetractin, with terminal branches.....	20. *Tetracladinidæ.*

(19.)	The spicules are chiefly tetracts with equal rays and candelabras.....	22.
	There are large tetract spicules with three equal rays lying tangentially in or beyond the surface, and one differentiated, radial ray ...	(23.)
22.	With small inconspicuous ciliated chambers with small outlets	24.
	With large conspicuous ciliated chambers with wide outlets.....	(25.)
24.	With candelabra	21. *Corticidæ.*
	With simple tetracts	22. *Pachastrellidæ.*

(25.)	With scattered tetracts, triacts, diacts	23. *Plakinidæ.*
	Without spicules	24. *Oscarellidæ.*

(23.)	Tetracts with differentiated large centripetal ray and large tangential rays numerous	26.
	Tetracts with differentiated large centripetal ray rare, with small tangential rays	(27.)
26.	With spherasters	25. *Geodidæ.*
	Without spherasters	28.
28.	Flesh-spicules euaster and oxyaster	26. *Stellettidæ.*
	Flesh-spicules spirastrella	27. *Theneidæ.*
	Flesh-spicules spirula and sigmata	28. *Tetillidæ.*

(27.)	Without flesh-spicules	29. *Tethyopsillidæ.*

(20.)	The widened distal ends of the radial spicule-bundles divide the regular subdermal cavities into ectochonæ or vestibules at the entrance of the inhalant canals	30. *Tethydæ.*
	Between the distal ends of the radial spicule-bundles ecto- and entochonæ are found	31. *Sollascllidæ.*
	The inhalant pores lead direct into the inhalant canals	29.
29.	With spirastrellid flesh-spicules	32. *Spirastrellidæ.*
	With sigmate flesh-spicules	33. *Suberamatidæ.*
	Without flesh-spicules	34. *Suberitidæ.*

(21.)	With polyact flesh-spicules	35. *Chondrillidæ.*
	Without flesh-spicules	36. *Chondrosidæ.*

(17.)	With proper spicules in the supporting skeleton.	30.	
	Without proper spicules in the supporting skeleton	(31.)	
30.	With uniformly distributed skeleton-reticulation and not very large subdermal cavities.	32.	
	The skeleton consists of a dense axial reticulation and isolated fibres extending from this to the surface. Between these very extensive subdermal cavities are situated	(33.)	
32.	With gemmulæ; living in fresh water	37.	*Spongillidæ*.
	Without gemmulæ	34.	
34.	Without flesh-spicules; fibres of the supporting skeleton not spined	38.	*Homorhaphidæ*.
	Flesh-spicules sigmata or spiral; no chelæ	39.	*Heterorhaphidæ*.
	Flesh-spicules chelæ; when absent, fibres of supporting skeleton spined	40.	*Desmacidonidæ*.

(33.) No chelæ ..... 41. *Axinellidæ*.

(31.)	With small spherical chambers and opaque ground-substance	35.	
	With large sac-shaped chambers and transparent ground-substance	(36.)	
35.	Without filaments in the ground-substance	37.	
	With filaments in the ground-substance	38.	
37.	Skeleton-fibres with thin axial canal	42.	*Spongidæ*.
	Skeleton-fibres tubular, with thick pith	43.	*Aplysinidæ*.

(38.) Skeleton-fibre with thin axial canal ..... 44. *Hircinidæ*

(36.)	Skeleton-fibres with thin axial canal; reticulate	45.	*Spongelida*.
	Skeleton-fibres tubular with thick pith; dendritic	46.	*Aplysillidæ*.
	No skeleton	47.	*Halisarcidæ*.

APPENDIX.

LIST OF PUBLICATIONS RELATING TO THE SPONGES.

(*Explanations of the Abbreviations used are appended.*)

1. **Ælianus, Claudius.** Περὶ ζώων. Liber 8, Cap. 16.

2. **Agassiz, Alexander.** (On Hexactinellids.) *Bull. Mus. C. Z.* 1868, p. 367 (1868).

3. **Aldrovandi, U.** De reliquis animalibus exanguibus nempe de Mollibus, Crustaceis, Testaceis et Zoophytis libri quatuor. Bononiæ, 1606. Fol. (2nd ed. 1618; 3rd ed. 1623; 4th ed. 1642.) (1606–1642.)

4. **Allman, G. J.** A new Order of Hydrozoa. *Ann. M. N. H.* ser. 4, vol. xiv. p. 237 (1874).

[5.] ——. A new Order of Hydrozoa. *Nature*, vol. x. p. 251 (1874).

6. ——. A new Order of Hydrozoa. *Tr. L. S.* vol. i. p. 61 (1875).

7. **Andrews, W.** On Irish Sponges. *Ann. M. N. H.* ser. 4, vol. i. pp. 307, 308 (1868).

8. **Aristoteles.** Περὶ ζώων ἱστορίας. Liber 1, cap. 1; Liber 5, cap. 16; Liber 8, cap. 1.

9. ——. Περὶ ζώων μορίων. Liber 4, Cap. 5.

10. **Audouin, J. V.,** et **Milne-Edwards.** Résumé des recherches sur les animaux sans vertèbres, faites aux îles Chausey. *Ann. Sci. Nat.* tom. xv. p. 5 (1828).

11. ——, ——. Recherches pour servir à l'histoire naturelle du Littoral de la France, ou recueil de mémoires sur l'anatomie, la physiologie, la classification et les mœurs des animaux de nos côtes. Tom. 1. Paris (1832).

12. **Austin, T.** Note on Mr. Bowerbank's paper on the genus *Dunstervillia* (Bwk.), with remarks on the *Ischadites Königii*, the *Tentaculites*, and the *Conularia*. *Ann. M. N. H.* ser. 1, vol. xv. p. 406 (1845).

13. **Badcock, T.** Red flints in the Chalk. *Nature*, vol. xxv. p. 529 (1882).

14. **Baier, J. J.** Oryctographia Norica, sive rerum fossilium et ad minerals regnum pertinentium in territorio Norimbergensi ejusque vicinia observatarum succincta descriptio. (1708.)

15. ——. Monumenta rerum petrif. Norimbergæ (1757).

16. **Baird, S. F.** American Sponges. United States Commission of Fish and Fisheries. Part 1. (1873.)

17. **Balfour, F. M.** The Morphology and Systematic Position of the Spongida. *J. R. Micr. Sci.* n. s. vol. xix. pp. 103–109 (1879).

[18.] ——. Sur la morphologie et la position systématique des Éponges. (Extr.) *Arch. Z. Expér.* tom. viii. pp. 5–8 (1880).

19. ——. Treatise on Comparative Embryology, vol. i. p. 18 (1880).

20. ——. On the structure and homologies of the germinal layers of the Embryo. *Q. J. Micr. Sci.* vol. xx. p. 247 (1880).

21. ——. Larval Forms. *Q. J. Micr. Sci.* vol. xx. p. 381 (1880).

22. **Balsamo-Crivelli, G.** Memoria di alcuni Spongiari del golfo di Napoli. *Atti Soc. Ital.* vol. v. pp. 284–302 (1863).

23. ——. Di alcuni organi speciali osservati in una Spugna. *Rendic. Ist. Lomb.* vol. iii. pp. 333–336 (1866).

24. **Barrois, C.** Spongiaires des sables d'Ostricourt et observations sur la phylogénie des Éponges. *Ann. Soc. Géol. Nord*, p. 71 (1875).

25. ——. Recherches sur le Terrain crétacé supérieur de l'Angleterre et de l'Irlande. (1876.)

26. ——. Mémoire sur l'Embryologie de quelques Éponges de la Manche (*Sycandra*, *Halisarca*, *Verongia*, *Isodictya*, *Desmacidon*). *Ann. Sci. Nat.* sér. 6, tom. iii. (1876).

[27.] ——. Embryologie de quelques Éponges de la Manche. (Extr.) *J. l'Anat. Phys.* tom. xii. pp. 656–661 (1876).

[28.] ——. On the development of Sponges. (Abstr.) *Monthl. Micr. J.* vol. xvi. pp. 254–256 (1876).

[29.] ——. Embryologie de quelques Éponges de la Manche. (Extr.) *Bull. Scient. du dép. du Nord*, tom. viii. pp. 151–155 (1877).

30. ——. Sur les Dictyospongidæ des Psammites des Chondroz. *Ann. Soc. Géol. Nord*, tom. xi. p. 80 (1883).

31. **Bauhin, J.** Hist. fontis Bollensis. Montisbelgardi (1598).
32. **Bauhin, J.**, et **Cherler, J. H.** Hist. plant. Ebroduni (1651).
33. **Bauhin, K.** Pinax Theatri Botanici. Basileæ, Helvet. (1623).
34. **Bell, T.** Remarks on the animal nature of Sponges. *Zool. Journ.* vol. i. p. 202 (1824).
35. **Bellamy, J. C.** Natural History of South Devon. London (1840).
36. **Belon, A.** De aquatilibus. Liber ii. Parisiis (1553).
37. **Beltremieux.** Faune du département de la Charente-Inférieur. (1860.)
38. **Beneaume.** Spongia fluviatilis fragilis et piscem olens. *Mém. Acad. Sci. Paris*, p. 231 (1814).
39. **Beneden, E. Van.** Die Cœlenteraten-Natur der Spongien. *Ber. Vers. Nat. Hannover*, p. 263 (1864).
40. **Benett, E.** Catalogue of the organic remains of the county of Wilts. Warminster (1831).
41. **Bennett, George.** On the *Euplectella aspergillum*, Owen, or "Venus's Flower-Basket." *Proc. R. Soc. Tasm.* pp. 59–65 (1875).
42. **Bertolini, A.** Rariorum Italiæ plantarum dec. 3 accedit specim. zoophyt. Portus Lunæ. Pisæ (1810).
43. ——. Sopra alcuni paradox nat. (Spongitarii) nel golfo della Spezia. Modena (1832).
44. **Bianchi, G.** De conchis minus notis. Ed. ii. Romæ (1760).
45. **Bianconi, G. G.** Sopra alcuni Zoofiti descriti sotto i nomi di *Cliona celata*, etc. *Nuovi Ann. Sci. Nat.* vol. vi. p. 455 (1841).
46. **Bigsby, J. J.** Thesaurus Siluricus. London (1868).
47. ——. Thesaurus Devonico-Carboniferus. London (1878).
48. **Billings, E.** Palæozoic fossils. *Geol. Surv. Canada*, Fasc. i. 1–5. Montreal (1861–1865).
49. ——. On some new or little-known Fossils from the Silurian and Devonian Rocks of Ontario. *Canadian Nat. and Geol.* n. s. vol. vii. (1875).
50. **Blainville, M. H. D. de.** Planches. ii. Partie, Zoologie, Vers et Zoophytes. *Dictionnaire Sci. Nat.*, Paris et Strasbourg (1816–1839).
51. ——. Éponges. *Dictionnaire Sci. Nat.* tom. xv. p. 93 (1819).
52. ——. Zoophytes. *Dictionnaire Sci. Nat.* tom. lx. p. 1 (1830).
53. ——. Manuel d'Actinologie et de Zoophytologie. Paris (1834–1837).
54. **Barboza du Bocage, J. V.** Note sur la découverte d'un Zoophyte de la famille Hyalochætides sur la côte du Portugal. *P. Z. S.* 1864, pp. 265–269 (1864).
55. ——. Sur l'habitat du *Hyalonema lusitanicum*. *P. Z. S.* 1865, pp. 662–663 (1865).
56. ——. On *Hyalonema lusitanicum*. *Ann. M. N. H.* ser. 3, vol. xx. pp. 123–127 (1867).
57. ——. Notes on *Hyalonema boreale* and a new Genus of Sponges. *Ann. M. N. H.* ser. 4, vol. ii. pp. 36–38 (1868).
58. ——. Éponges siliceuses nouvelles de Portugal et de l'île St. Jago : *Podospongia lovenii*, *Reniera* (?) *grayi*, *Discodermia polydiscus*, *Latrunculia cratera*. *J. Sci. Lisb.* tom. ii. pp. 159–161 (1870).
59. ——. Sur l'existence de la *Holtenia carpenteri*, Wyville Thomson, dans les côtes du Portugal. *J. Sci. Lisb.* tom. iii. pp. 69–70 (1870).
60. **Boerhave, H.** Index alter. plant. hort. Lugd. Batav. (1720).
61. **Bosc, L. A. G.** Histoire Naturelle des Vers. Paris, tom. iii. (1802).
62. ——. Histoire Naturelle des Vers. Paris, tom. iii. 2nd. edit. (1827).
63. **Bourguet, L.**, et **Cortier, P.** Traité des pétrefactions. Paris (1742).

64. **Bowerbank, J. S.** On the Keratose or Horny Sponge of commerce. *Micr. J.* vol. i. pp. 8–11 (1841).

65. ——. Descriptions of three species of Sponge containing some new forms of organization. *Micr. J.* vol. i. pp. 161–162 (1841).

66. ——. Observations on a Keratose Sponge from Australia. *Ann. M. N. H.* ser. 1, vol. vii. p. 129 (1841).

[67.] ——. Sur les Kératoses ou Éponges cornées du commerce. (Trad.) *L'Institut*, tom. ix. no. 382, p. 137 (1841).

68. ——. On the spongeous origin of Mossagates and other siliceous bodies. *Ann. M. N. H.* ser. 1, vol. x. p. 9 (1842).

69. ——. On the spongeous origin of Mossagates and other siliceous bodies. *Ann. M. N. H.* ser. 1, vol. x. p. 84 (1842).

70. ——. On the Keratose or Horny Sponges of commerce. *Tr. R. Micr. Soc.* vol. i. pp. 32–39 (1844).

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1629. ——. Studies on Fossil Sponges. I. *Hexactinellidæ*. *Ann. M. N. H.* ser. 4, vol. xx. pp. 501–517 (1877).

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1642. ——. Studies on Fossil Sponges. II. *Lithistidæ*. *Ann. M. N. H.* ser. 5, vol. ii. pp. 324–341 (1878).

1643. ——. Studies on Fossil Sponges. II. *Lithistidæ*. *Ann. M. N. H.* ser. 5, vol. ii. pp. 385–394 (1878).

1644. ——. Studies on Fossil Sponges. II. *Lithistidæ*. *Ann. M. N. H.* ser. 5, vol. ii. pp. 467–482 (1878).

1645. ——. Studien über fossile Spongien. III. *Monactinellidæ*, *Tetractinellidæ*, und *Calcispongiæ*. *Abh. bayer. Ak.* vol. xiii. pt. 2, pp. 1–48 (1879).

1646. ——. Studies on Fossil Sponges. III. *Monactinellidæ*; IV. *Tetractinellidæ*; V. *Calcispongiæ*. *Ann. M. N. H.* ser. 5, vol. iii. pp. 304–313 (1879).

1647. ——. Beiträge zur Systematik der fossilen Spongien. *Neues Jahrb. Mineral. Geol.* 1879, pp. 1–40 (1879).

1648. **Zittel, K. A.** Studies on Fossil Sponges. V. *Calcispongiæ*. *Ann. M. N. H.* ser. 5, vol. iii. pp. 364–379 (1879).

1649. ——. Studies on Fossil Sponges. V. *Calcispongiæ*. *Ann. M. N. H.* ser. 5, vol. iv. pp. 61–73 (1879).

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1654. **Zoholka, C.** Ueber *Isoraphinia texta*, Rœm. sp., und *Scytalia pertusa*, Reuss, sp., aus der Umgebung von Raudnitz an der Elbe, Böhmen. *SB. Ak. Wien*, Bd. iv. pp. 647–652 (1886).

LIST OF THE PRINCIPAL ABBREVIATIONS USED IN THE LIST OF PUBLICATIONS.

Abh. Ak. Berl.—Abhandlungen der königlichen preussischen Akademie der Wissenschaften zu Berlin.

Abh. bayer. Ak.—Abhandlungen der mathematisch-physikalischen Classe der k bayerischen Akademie der Wissenschaften. (München.)

Abh. kgl. Ges. Wiss. Prag.—Abhandlungen der königlichen Gesellschaft der Wissenschaften zu Prag.

Actes Soc. Jura. d'Emul. Porren.—Actes de la Société Jurassienne d'Emulation. (Porrentruy.)

Act. Soc. Lin. Bordeaux.—Actes de la Société Linnéenne de Bordeaux.

Am. J. Sci.—American Journal of Science and Art. (New Haven.)

Am. Micr. J.—American Monthly Microscopical Journal. (New York.)

Am. Nat.—American Naturalist.

Ann. Chemie Physik.—Annales de Chemie et Physique.

Ann. du Mus.—Annales du Muséum d'histoire Naturelle de Paris.

Ann. Lyceum N. H. New York.—Annals of the Lyceum of Natural History of New York.

Ann. M. N. H.—Annals and Magazine of Natural History. (London.)

Ann. of Philos.—Annals of Philosophy, or Magazine of Chemistry, Mineralogy, &c. (London.)

Ann. regno Lomb.-Venet.—Annali di Scienze regno Lombardo-Venetiana.

Ann. Sci. Nat.—Annales des Sciences Naturelles. (Paris.)

Ann. Soc. géol. Nord.—Annales de la Société géologique du Nord. (Lille.)

Ann. Soc. mal. Belg.—Annales de la Société malacologique de Belgique. (Brussels.)

Annual Rep. State Cabinet Nat. Hist. New York.—Annual Report of the Regents University of New York on the condition of the State Cabinet. (New York.)

Arb. nat. Ges. Univ. Charkow.—Arbeiten der naturforschenden Gesellschaft der Universität Charkow. (Charkow.)

Arb. Petersb. Ges.—Arbeiten der St. Petersburger naturforschenden Gesellschaft.

Arb. z. Inst. Wien.—Arbeiten aus dem zoologischen Institute der Universität Wien. (Vienna.)

Arch. Anat. Phys.—Archiv für Anatomie und Physiologie. (Liepzig.)

Arch. f. Nat.—Archiv für Naturgeschichte. (Berlin &c.)

Arch. mikr. Anat.—Archiv für mikroskopische Anatomie. (Bonn.)

Arch. Néerl.—Archives Néerlandaises des Sciences exactes et naturelles. (The Hague.)

Arch. nouv. Mus.—Archives nouvelles du Muséum. (Paris.)

Arch. Sci. Nat.—Archives des Sciences Naturelles. (Paris.)

Arch. Slav. Biol.—Archives Slaves de Biologie.

Arch. Ver. Mecklenburg.—Archiv des Vereins der Freunde der Naturgeschichte in Mecklenburg. (Neu Brandenburg.)

Arch. Z. expér.—Archives de Zoologie expérimentale et générale. (Paris.)

Assoc. franç. Av. Sci.—Association français pour l'avancement des Sciences. (Paris.)

Atti Ac. Rom.—Atti della R. Accademia delle Scienze. (Rome).

Atti Ist. Venet.—Atti dell' I. R. Istituto Veneto di Scienze, Lettere ed Arti. (Venice.)

Atti Soc. Ital.—Atti della Società Italiana di Scienze naturali. (Modena &c.)

Atti Soc. Tosc.—Atti della Società Toscana di Scienze naturali, residente in Pisa.

Beitr. balt. Wochens.—Beiträge zur baltischen Wochenschrift.

Belfast Nat. Hist. Field-Club Report.—Reports of the Belfast Natural-History Field-Club.

Ber. Com. wiss. Unters. deutsch. Meere, Kiel.—Bericht der Commission zur Untersuchung der deutschen Meere. (Kiel.)

Ber. Vers. Nat.—Amtlicher Bericht deutscher Naturforscher und Ärzte.

Berl. Monatsh.—Berliner Monatshefte.

Bibl. Hautes Etud.—Bibliothèque de l'école des Hautes Études. (Paris.)

Bih. Sv. Ak. Handl.—Bihang till Kongl. Svenska Vetenskaps-Akademiens Handlingar. (Stockholm.)

Bijdr. Dierk.—Bijdragen tot de Dierkunde. (Amsterdam.)

Biol. Centralbl.—Biologisches Centralblatt. (Erlangen.)

Brit. Mus.—British Museum Catalogue. (London.)

Bull. Ac. Belg.—Bulletin de l'Académie Royale des Sciences de Belgique. (Brussels.)

Bull. Ac. Pétersb.—Bulletin de la classe physico-mathématique de l'Académie Impériale des Sciences de St. Pétersbourg.

Bull. Am. Mus. Nat. Hist.—Bulletin of the American Museum of Natural History. (New York.)

Bull. Buff. Nat. Club.—Bulletin of the Buffalo Naturalists' Club. (Buffalo, N. Y.)

Bull. Mosc.—Bulletin de la Société Impériale des Naturalistes de Moscou.

Bull. Mus. C. Z.—Bulletin of the Museum of Comparative Zoology. (Cambridge, U.S.A.)

Bull. Scient.—Bulletin Scientifique du département du Nord.

Bull. Soc. Acclim.—Bulletin de la Société d'Acclimatation. (Paris.)

Bull. Soc. Adriat.—Bulletin de la Société Adriatique.

Bull. Soc. Linn. Normandie.—Bulletin de la Société Linnéenne de Normandie. (Caen.)

Bull. Soc. Géol.—Bulletin de la Société géologique de France. (Paris.)

Bull. Soc. Vaudoise.—Bull. de la Société Vaudoise.

Bull. Soc. Sci. Nat. Neuchâtel.—Bulletin de la Société des Sciences Naturelles. (Neuchâtel.)

Bull. Soc. Zool. Fr.—Bulletin de la Société Zoologique de France. (Paris.)

Canadian Nat. and Geol.—Canadian Naturalist and Geologist.

Can. Nat.—Canadian Naturalist.

Centralbl. med. Wiss.—Centralblatt für die medicinischen Wissenschaften. (Berlin.)

Comm. Akad. Petropol.—Commentarii Academiæ Scientiarum Imperialis Petropolitanæ. Académie Impériale des Sciences. (Petersburg.)

C. R.—Comptes rendus des Séances hebdomadaires de l'Académie des Sciences. (Paris.)

C. R. Soc. Biol.—Comptes rendus des Séances et Mémoires de la Société de Biologie. (Paris.)

Denk. Ak. Wien.—Denkschriften der k. Akademie der Wissenschaften zu Wien. (Vienna.)

Dictionnaires Sci. Nat.—Dictionnaires des Sciences Naturelles. (Paris.)

D. Litt. Zeit.—Deutsche Litteratur Zeitung.

Edinb. New Phil. Journ.—Edinburgh New Philosophical Journal. (Edinburgh.)

Edinb. Phil. Journ.—Edinburgh Philosophical Journal. (Edinburgh.)

Encyclop. méth.—Encyclopédie méthodique des sciences. (Paris.)

Féruss. Bull. Sc. Nat.—Bulletin des Sciences Naturelles et de Géologie publié par M. le Baron de Férussac. (Paris.)

Fror. Notizen.—Notizen aus dem Gebeite der Natur- und Heilkunde (Froriep). (Erfurt.)

Geol. Mag.—Geological Magazine. (London.)

Geol. Surv. Canada.—Geological Survey of Canada.

Gr. Arch. mikr. Anat.—Grenacher's Archiv für mikroskopisch Anatomie.

Hist. Berw. Nat. Club.—Berwickshire Naturalists' Club.

Hist. et Mém. Acad. Paris.—Histoires et Mémoires de l'Académie des Sciences. (Paris.)

Ill. d. Monatshefte.—Illustrierte deutsche Monatshefte.

J. Ac. Philad.—Journal of the Academy of Natural Sciences, Philadelphia.

Jahrb. Mineral.—Jahrbuch für Mineralogie, Geognosie, Geologie, &c. (Stuttgart.)

J. Bombay Branch R. Asiatic Soc.—Journal of the Bombay Branch of the Royal Asiatic Society.

JB. schles. Ges.—Jahresberichte des schlesischen Gesellschaft für vaterländische Cultur. (Breslau.)

JB. schlesw. Gesell.—Jahresbericht der naturwissenschaftlichen Gesellschaft in Schleswig.

J. Chim. expérim.—Journal de la Chimie expérimentale.

J. Cincinnati Soc. Nat. Hist.—Journal of the Cincinnati Society of Natural History.

J. d. Zool.—Journal de Zoologie. (Paris.)

Jen. Z. Nat.—Jenaische Zeitschrift für Naturwissenschaften, herausgegeben von der medicinisch-naturwissenschaftlichen Gesellschaft zu Jena.

J. G. Soc.—Quarterly Journal of the Geological Society. (London.)

JH. Ver. Württ.—Jahreshefte des Vereins für vaterländische Naturkunde in Württemburg. (Stuttgart.)

J. l'Anat. Phys.—Journal de l'Anatomie et de la Physiologie. (Paris.)

J. L. S.—Journal of the Linnean Society (Zoology). (London.)

J. Microgr.—Journal de Micrographie. (Paris.)

J. N. York Micr. Soc.—Journal of the New York Microscopical Society.

J. of Conch.—Journal of Conchology.

J. prakt. Chem.—Journal für praktische Chemie. (Leipzig.)

J. Quek. Club.—Journal of the Quekett Microscopical Club. (London.)

J. R. Micr. Soc.—Journal of the Royal Microscopical Society. (London.)

J. Sci. Lisb.—Jornal de Sciencias da Academia de Lisboa. (Lisbon.)

Kgl. Svenska Vetensk.-Akad. Handlingar.—Kongliga Svenska Vetenskaps-Aakademiens Handlingar. (Stockholm.)

L'Institut.—L'Institut de France.

Mag. N. H.—Magazine of Natural History (Charlesworth). (London.)

Mag. Zool. Bot.—Magazine of Zoology and Botany. (London.)

Manual of Nat. Hist. &c. of Greenland.—Manual of the Natural History of Greenland.

Math.-nat. Ber. Ungarn.—Berichte des Ungarischen mathematisch-naturwissenschaftlichen Gesellschaft.

MB. Ak. Berl.—Monatsberichte der k. preussischen Akademie der Wissenschaften zu Berlin.

Meddel. af Soc. pro Fauna et Flora Fennica.—Meddelingen af Societat pro Fauna et Flora Fennica.

Mél. Biol. Pétersb.—Mélanges Biologiques tirés du Bulletin de la classe physico-mathématique de l'Académie Imp. des Sciences de St. Pétersbourg.

Mém. Ac. Pétersb.—Mémoires de l'Académie impériale des Sciences de St. Pétersbourg.

Mém. Acad. Sci. Paris.—Mémoires de l'Académie des Sciences. (Paris.)

Mem. Acc. Tor.—Memorie della Reale Accademia delle Scienze. (Turin.)

Mem. Bost. Soc.—Memoirs of the Boston Society of Natural History.

Mém. d. Mus.—Mémoires du Muséum d'Histoire Naturelle. (Paris.)

Mém. Soc. Géol. France.—Mémoires de la Société Géologique de France.

Mém. Soc. Helvétique Sci. Nat.—Mémoires de la Société Helvétique des Sciences Naturelles. (Lausanne.)

Mém. Soc. Hist. Nat. Paris.—Mémoires de la Société des Sciences Naturelles de France. (Paris.)

Mém. Soc. Imp. Sci. Nat. Cherbourg.—Mémoires de la Société des Sciences Naturelles. (Cherbourg.)

Mém. Soc. Jura. d'Emul. Départ. du Doubs.—Mémoires de la Société Jurassienne d'Emulation Département du Doubs.

Mém. Soc. nouv. Russ.—Mémoires de la Société nouvelle de la Russie.

Mem. Wern. Soc.—Memoirs of the Wernerian Natural-History Society. (Edinburgh.)

Micr. J.—The Microscopical Journal and Structural Record. (London.)

Monthl. Micr. J.—Monthly Microscopical Journal. (London.)

Morph. Jahrb.—Morphologisches Jahrbuch: eine Zeitschrift für Anatomie und Entwickelungsgeschichte. (Leipzig.)

MT. Ges. Bern.—Mittheilungen der naturforschenden Gesellschaft in Bern.

MT. JB. geol. Anst. Budapest.—Mittheilungen aus dem Jahrbuche der königlich-ungarischen geologischen Anstalt. Budapest.

MT. Mus. Dresden.—Mittheilungen aus dem k. zoologischen Museum zu Dresden.

MT. Ver. Stcierm.—Mittheilungen des naturwissenschaftlichen Vereins für Steiermark. (Graz.)

MT. z. Stat. Neap.—Mittheilungen der zoologischen Station in Neapel. (Leipzig.)

Naturf.—Naturforscher.

Naturk. Verh. Utrecht.—Natuurkundige Verhandelingen Provinciaal Utregtsch Genootschap van Kunsten en Weteuschappen. (Utrecht.)

Natuurk. Tijdschrift voor Nederlandsch Indië.—Natuurkundig Tijdschrift voor Nederlandsch Indië. (Batavia.)

Nederl. Staatscourant.—Nederlandsch Staatscourant.

Neues Jahrb. Mineral. Geol.—Neues Jahrbuch für Mineralogie, Geologie und Petrefaktenkunde. (Heidelberg, Stuttgart, &c.)

New Russian Nat. Hist.—Transactions of the New Russian Society of Natural History. (Russian.)

New Z. J. Sci.—The New Zealand Journal of Sciences. (Dunedin.)

Niederl. Arch. Zool.—Niederländisches Archiv für Zoologie. (Haarlem.)

Nors. Vid. Selsk. Skrifter.—Kongliga Norske Videnskabers Selskabs Skrifter. (Trondjem.)

Notes Leyd. Mus.—Notes from the Royal Zoological Museum of the Netherlands at Leyden.

Nouveaux Mém. de la S. Helvétique Sc. Nat.—Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles. (Lausanne.)

Nova Acta natur. curios.—Nova Acta naturæ curiosorum.

Nuovi Ann. Sci. nat.—Nuovi Annali delle Scienze naturali Bologna.

Öfv. Vet.-Ak. Förh.—Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar. (Stockholm.)

P. Ac. Philad.—Proceedings of the Academy of Natural Sciences of Philadelphia.

Pal.—Paleontographica.

P. Am. Assoc.—Proceedings of the American Association.

P. Belf. Soc.—Proceedings of the Belfast Natural History and Philosophical Society.

P. Bost. Soc.—Proceedings of the Boston Society of Natural History.

P. Bristol Nat. Soc.—Proceedings of the Bristol Natural History Society.

P. Cambridge Phil. Soc.—Proceedings of the Cambridge Philosophical Society.

P. Geol. Assoc.—Proceedings of the Geologists' Association.

Phil. Mag.—Philosophical Magazine. (London.)

Phil. Tr.—Philosophical Transactions of the Royal Society. (London.)

Pop. Sci. Review.—Popular Science Review.

P. Linn. Soc.—Proceedings of the Linnean Society of London.

P. Linn. Soc. N. S. W.—Proceedings of the Linnean Society of New South Wales. (Sydney.)

P. Liverp. Soc.—Proceedings of the Literary and Philosophical Society and Natural History Society of Liverpool.

P. Med. Soc. Edinburgh.—Proceedings of the Medical Society of Edinburgh.

P. R. Irish Ac.—Proceedings of the Royal Irish Academy. (Dublin.)

Proc. Lit. Liverpool.—Proceedings of the Literary and Philosophical Society of Liverpool.

Proc. Yorkshire Phil. Soc.—Proceedings of the Yorkshire Philosophical Society. (York.)

P. R. Soc.—Proceedings of the Royal Society. (London.)

P. R. Soc. Edinburgh.—Proceedings of the Royal Society of Edinburgh.

P. R. Soc. Tasm.—Papers and Proceedings and Reports of the Royal Society of Tasmania.

P. U. S. Nat. Mus.—Proceedings of the United States National Museum. (Washington.)

P. Z. S.—Proceedings of the Zoological Society. (London.)

Q. J. Micr. Sci.—Quarterly Journal of Microscopical Science. (London.)

Rendic. Accad. Sc. Napoli.—Rendiconti della R. Accademia delle Scienze di Napoli. (Naples.)

Rendic. Ist. Lomb.—Rendiconti del R. Istituto Lombardo di Scienze. (Milan.)

Rep. Brit. Assoc.—Reports of the British Association for the Advancement of Science.

Rep. R. Polytechnical Soc. Cornwall.—Reports of the Royal Polytechnical Society of Cornwall.

Rep. U. S. Fish Comm.—Report of the Commissioner, United States Commission of Fish and Fisheries. (Washington.)

Revue Zool.—Revue Zoologique. (Paris.)

Rozpr. i Spraw. Akad. umieg. af Krakowie.—Proceedings of the Cracow Academy.

SB. Ak. Berlin.—Sitzungsberichte der königlich-preussischen Akademie der Wissenschaften zu Berlin.

SB. Ak. Wien.—Sitzungsberichte der mathematisch-naturwissenschaftliche Classe der k. Akademie der Wissenschaften. (Vienna.)

SB. böhm. Ges.—Sitzungsberichte der k. böhmischen Gesellschaft der Wissenschaften. (Prague.)

SB. Dresden.—Sitzungsberichte der naturwissenschaftlichen Gesellschaft Isis in Dresden.

SB. Ges. Dorp.—Sitzungsberichte der Dorpater Naturforscher Gesellschaft. (Dorpat.)

SB. Ges. Leipzig.—Sitzungsberichte der königlich sächsischen Gesellschaft der Wissenschaften. (Leipzig.)

SB. nat. Fr.—Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin.

SB. niederrhein. Ges.—Sitzungsberichte des niederrheinischen Gesellschaft für Natur- und Heilkunde. (Bonn.)

SB. Soc. Erlangen.—Sitzungsberichte der physikalisch-medicinischen Societät zu Erlangen.

Schrift. Dronth. Ges.—Schriften der Drontheimer Gesellschaft.

Schrift. Gesell. Bef. Naturwissens. Marburg.—Schriften der Gesellschaft zur Beförderung der Naturwissenschaften in Marburg.

Schr. Ges. Danz.—Schriften der naturforschenden Gesellschaft zu Danzig.

Sci. Gos.—Science Gossip.

Skrifter Naturhist. Selsk.—Det Kongelige Danske Videnskabernes Selskabs Skrifter. (Copenhagen.)

Sm. Misc. Coll.—Smithsonian Miscellaneous Collections. (Washington.)

Sm. Misc. Contrib.—Smithsonian Miscellaneous Contributions to Knowledge. (Washington.)

Soc. Philom. Paris.—Rapports Généraux des Travaux de la Société Philomatique. (Paris.)

Tijdschr. Nederl. Dierk. Vereen.—Tijdschrift der Nederlandsche Dierkundige Vereeniging. (Leiden.)

Todd's Cyclop. Anat.—Todd's Cyclopædia of Anatomy.

T. R. Irish Ac.—Transactions of the Royal Irish Academy. (Dublin.)

Tr. Albany Inst.—Transactions of the Albany Institute.

Tr. Birmingham Soc.—Transactions of the Birmingham Society.

Tr. Connecticut Ac. Sci.—Transactions of the Connecticut Academy of Science.

Tr. Devon. Assoc.—Report and Transactions of the Devonshire Association for the Advancement of Science, &c. (Plymouth.)

Tr. Geol. Soc.—Transactions of the Geological Society of London.

Tr. L. S.—Transactions of the Linnean Society of London.

Tr. Newbury District Field-Club.—Transactions of the Newbury District Field-Club.

Tr. new Russian N. H. Soc.—Transactions (Trapiski) of the new Russian Natural History Society.

Tr. North. Durh.—Natural History Transactions of Northumberland and Durham. (Newcastle-on-Tyne.)

Tr. R. Asiatic Soc. Japan.—Transactions of the Royal Asiatic Society. Japan Branch.

Tr. R. Dublin Soc.—Transactions of the Royal Society of Dublin.

Tr. R. Micr. Soc.—Transactions of the Royal Microscopical Society of London.

Tr. R. Soc. Edinb.—Transactions of the Royal Society of Edinburgh.

Tr. Tynes. N. Club.—Transactions of the Tyneside Naturalists' Field-Club. (Newcastle-upon-Tyne.)

Tr. Z. S.—Transactions of the Zoological Society of London.

Uebers. Arb. schles. Ges. Breslau.—Uebersicht der Arbeiten und Verhandlungen des schlesischen naturwissenschaftlichen Gesellschaft in Breslau.

Unters. Phys. Inst. Heidelb.—Untersuchungen aus dem physiologischen Institut der Universität Heidelberg.

Vergl. phys. Studien.—Vergleichend physiologische Studien.

Verh. d. Akad. Wetensch.—Verhandelingeu der Akademie van Wetenschappen.

Verh. geol. Reichsans.—Verhandlungen der k.-k. geologischen Reichsanstalt. (Vienna.)

Verh. naturf. Gesell. Zürich.—Verhandlungen der naturforschenden Gesellschaft in Zürich.

Verh. naturh. Ver. Heidelb.—Verhandlungen des naturhistorisch-medicinischen Vereins zu Heidelberg.

Verh. naturh. Ver. Rheinl.—Verhandlungen des naturhistorischen Vereins der preussischen Rheinlande und Westfalens. (Bonn.)

Verh. phys. Ges. Berlin.—Verhandlungen der physikalischen Gesellschaft zu Berlin.

Verh. phys.-med. Gesell. Würzb.—Verhandlungen der physikalisch-medicinischen Gesellschaft in Würzburg.

Verh. z.-b. Wien.—Verhandlungen der zoologisch-botanischen Gesellschaft in Wien. (Vienna.)

Würzb. naturw. Zeitschr.—Würzburger naturwissenschaftliche Zeitschrift.

Z. geol. Ges.—Zeitschrift der deutschen geologischen Gesellschaft. (Berlin.)

Z. ges. Naturw.—Zeitschrift für die gesammten Naturwissenschaften. (Berlin.)

Zool. Anz.—Zoologischer Anzeiger. (Leipzig.)

Zool. Jahrb.—Zoologische Jahrbücher. Zeitschrift für Systematik, Geographie und Biologie der Thiere. (Jena.)

Zool. Journ.—The Zoological Journal. (London.)

Z. wiss. Zool.—Zeitschrift für wissenschaftliche Zoologie. (Leipzig.)

3. On Indian Earthworms.—Part I. Preliminary Notice of Earthworms from the Nilgiris and Shevaroys. By Alfred Gibbs Bourne, D.Sc. (Lond.), F.L.S., Fell. Univ. Coll. Lond., Fell. Madras Univ., Professor of Biology in the Presidency College, Madras. (Communicated by Prof. Ray Lankester, F.Z.S.)

[Received November 16, 1886.]

When I commenced to find out what Earthworms were to be found here for the purposes of class-study, I was totally unprepared for the immense variety of forms which seem to occur in the country. I have at present examined a very few localities only, and as every locality yields new forms and I have already found more than twenty different species, all of which were hitherto unknown, the field may be pronounced to be fairly extensive.

I came across very few worms in my garden in Madras during the hot weather, but then I made no special search for them; those I did find belonged to the genus *Perichæta*, but seemed to be new species (I have since determined that they are new); I have found up to the present at least three species of *Perichæta* in Madras town, but have reserved them for subsequent description.

In May I went up to the Nilgiris for some weeks, and there I found numerous forms, and these always differed in different localities. In October I spent about a week on the Shevaroy Hills, and found in that short time five different forms, all markedly differing from those from the Nilgiris.

I regret that in some cases I was unable to render my observations complete, owing to want of sufficient material. It seems, however, desirable to publish this preliminary note even though it is in some cases incomplete, as more thorough investigations in any particular locality may be considerably delayed. The greater number of forms belong to the genera *Perichæta* and *Moniligaster*, and for the present I deal with these only. I have found, in addition to these, two species of *Lumbricus* at great elevations at Ootacamund and Coonoor. One of these presents a clitellum extending over somites xxvii.–xxxiv., and the other over somites xxx.–xxxiv. I refrain from naming these until I can characterize them more fully. I have also some worms belonging to other genera, but with the scanty literature to which I have access I cannot say whether they are new genera or not.

Had it not been for Mr. Benham's[1] most useful *résumé* of known Earthworms, I should have been able to do far less than I have done. Where I have given measurements or counted the somites I have chosen the largest individual I could find.

Perichætidæ.

The Perichætidæ are characterized by the fact that each somite bears numerous setæ arranged in a more or less complete ring.

The genera which are at present included in the group are:—*Perichæta*, Schm.; *Megascolex*, Temp. (*Pleurochæta*, Bedd.); *Perionyx*, E.P.; and *Rhodopis*, Kinb.

These genera are at present distinguished one from the others, thus:—

Perichæta presents a clitellum in somites xiv., xv., and xvi., a pair of laterally-placed male pores in somite xviii., and very numerous equidistant setæ.

Megascolex presents 100 setæ arranged in a ring, but with a dorsal break.

Perionyx presents a clitellum in somites xiii., xiv., xv., xvi., and xvii., a pair of male pores placed in a median pit in somite xviii., and 30 equidistant setæ.

Rhodopis presents a clitellum in somites xii. and xiii., a pair of male pores between somites xiv. and xv., and 50 to 60 equidistant setæ.

Now let us consider these characters in relation to the worms described below. Among these we find that there are numerous intermediate conditions, in respect to the arrangement of the setæ, between an *almost* equidistant series and a series presenting considerable dorsal and ventral gaps[2]. Secondly, in one form there are two pairs of male pores (*P. stuarti*). Lastly, with regard to the extent of the clitellum, in the form which I have referred to Perrier's genus *Perionyx* it extends over three somites instead of five, while among the

[1] Quart. Journ. Microsc. Sci. vol. xxvi. n. s.

[2] By the terms ventral and dorsal gaps I mean the space between the two most ventral and dorsal setæ respectively. An ordinary gap is the space between any other two contiguous setæ.

numerous forms which I have called *Perichæta* it extends in many forms (as in *P. armata*, Bedd.) over four somites, and in one form over five somites instead of three.

So, as they stand, these generic distinctions seem to me to be of little value. I am, however, inclined to hope that a careful anatomical study in the fresh state of the large variety of forms which I have already discovered (I have, moreover, every reason to believe that the field is as yet by no means exhausted[1]) will enable me to group these very interesting forms in a more rational manner. I do not think that the classification suggested by Benham[2] will turn out to be a very natural one. I refrain, however, from making any suggestions myself in this preliminary note, as I expect that the natural classification will have to be based upon the result of very careful examination of a very large number of fresh forms. I shall doubtless be able ere long to go to Ceylon, Burmah, Java, and other places, and compare fresh specimens of the forms which have been described from these regions with my Indian species.

I have in the present note spoken of all the forms as *Perichæta*, with the exception of *Perionyx saltans*, although I believe that the differences have in many cases a full generic value. A glance at my tabular statement (p. 665) will show what great differences exist.

PERICHÆTA LAWSONI, sp. n.

The clitellum extends over somites xiv., xv., xvi., and xvii., but is very slightly marked. Even in adult specimens it requires careful examination to detect any external difference between these somites and the ordinary somites of the body. There is, however, no doubt as to its existence and extent in either this or the following species, *P. bivaginata*.

The male pores are placed on somite xviii. There are no papillæ. The oviducts open separately, although very near the median line, in somite xiv. There are two pairs of spermathecæ; these are placed in somites viii. and ix. The spermathecal pores open between somites vii. and viii., and viii. and ix., respectively. I have found no nephridia. The gizzard is situated in somite x. Intestinal cæca are present in somite xxvi. and run forward to somite xxiii.

There are from 30–35 setæ in each somite, which are arranged so as to leave small gaps in the median, dorsal, and ventral line. The ventral gap is equivalent to about two ordinary gaps, and the dorsal gap to about three ordinary gaps. The setæ are present on the clitellar somites and are arranged as in the other somites. No modified genital setæ were observed.

Length 250 millim., circumference 7 mm.; number of somites 119.

Hab. Ootacamund, Nilgiris, at an elevation of about 7000 feet.

[1] In the one week which I recently spent in the Salem and Yercaud district, it will be seen that I discovered three new species of *Perichæta*, besides other forms.

[2] Quart. Journ. Microsc. Sci. vol. xxvi. n. s. p. 225.

CHARACTERS OF THE SPECIES OF *Perichæta* AND *Perionyx* HERE DESCRIBED.

Species.	Clitellar Somites.	Male pores.	Female pore.	Position of Spermathecæ.	Character of Spermathecæ.	Copulatory setæ.	Gizzard.	Intestinal cæca.	Number of setæ per somite.	Arrangement of setæ.	Number of somites.	Length and circumference.	Habitat.	Elevation.
												mm.		ft.
Perichæta lawsoni.	xiv., xv., xvi., xvii., very slightly marked.	xviii.; no papillæ.	xiv., paired.	viii., ix.	?	Not seen.	x.	xxvi.	30–35	Present on clitellum; small dorsal and ventral gaps.	119	250 7	Nilgiris (Ootacamund and Naduvatam).	6500 to 7500
P. bivaginata ...	xiv., xv., xvi., xvii., very slightly marked.	xviii.	xiv., paired.	vii., viii., ix.	With two minute appendices.	At least three pairs in xviii.	vi.	Absent.	56	Present on clitellum; small dorsal and ventral gaps.	162	140 8	Salem.	1000
P. gracilis	xiv., xv., xvi., xvii., xviii.	xviii., in clitellum.	xiv., paired.	viii., ix. (?)	Not seen.	Not seen.	vii.?	?	?	Present on clitellum; large dorsal and ventral gaps.	332	400 8	Nilgiris (Naduvatam).	6000
P. stuarti	xiv., xv., xvi.	xvii., xix., four in number.	xiv., single.	vii., viii.	Frill at base.	Special setæ in viii.	x.	4 pairs, about xxiii. to xxvi.	52	Present on clitellum; small gaps.	111	140 15	Shevaroys (Salem and Yercaud).	1000 to 5000
P. burliarensis	xiv., xv., xvi., xvii.	xviii.	xiv., single.	vi., vii., viii., ix.	With a long small appendix.	Special setæ in vii. & in viii.	x.	xxvi.	38–40	Absent on clitellum; ventral gaps unequal.	123	100 9	Nilgiris (Burliar).	2000 to 3000
P. hulikalensis	xiv., xv., xvi., xvii.	xviii.	xiv., single.	vii., viii.	With long thin appendix.	Absent.	?	I think present in xxvi.	42	Present on clitellum; large gaps.	209	200 9	Nilgiris (Hulikal-drug).	6000
P. mirabilis ...	xiv., xv., xvi.	xviii.	xiv., single.	vi., vii., viii., ix.	With long pouch-like appendix.	No observation.	x.	xxvi.	39	No gaps.	114	130 8	Nilgiris (Naduvatam).	6000
P. salettensis ...	xiv., xv., xvi., xvii.	xviii.	xiv., single.	vii., viii., ix.	Two small appendices.	Absent.	vi.	No observation.	?	?	112	70 9	Salem.	1000
Perionyx saltans.	xiv., xv., xvi.	xviii., in median pit.	xiv., single.	vi., vii., viii.	Two small appendices. Apert. near median line.	Absent.	?	No observation.	45–54	Present on clitellum; no gaps.	61	60 6	Nilgiris (Ootacamund, Naduvatam).	6500 to 7500

PERICHÆTA BIVAGINATA, sp. n.

This species resembles *P. lawsoni* in the condition of the clitellum and in having separate oviducal pores.

The clitellum extends over somites xiv., xv., xvi., and xvii., but is very slightly marked.

The male pores are placed on somite xviii., they are inconspicuous; there are no papillæ, although special penial setæ are present.

The oviducts open separately, very near together, in somite xiv., ventrad of the ventral setæ.

There are three pairs of spermathecæ; these are placed in somites vii., viii., and ix. The spermathecal pores open between somites vi. and vii., vii. and viii., viii. and ix., respectively. Each spermatheca possesses a pair of small diverticula at its base. Nephridia are present in most somites, if not all, and are very large and present rosettes of tubules in certain anterior somites, I think in v., vii., and ix. The nephridiopores I have not observed.

The gizzard is situated in somite vi. Intestinal cæca are absent.

There are about 56 setæ in each somite, which are arranged so as to leave small dorsal and ventral gaps, as in *P. lawsoni*. The setæ are also present on the clitellar somites.

There are a pair of small sacs in somite xviii. containing long, thin, curved, ornamented setæ, as in *P. armata*, Beddard [1]. Each sac contains at least 3 setæ.

Length 140 millim., circumference 8 mm.; number of somites 162.

Hab. Salem (about 1000 ft.), in wet ground.

PERICHÆTA (PLEUROCHÆTA?) GRACILIS, sp. n.

The clitellum extends over somites xiv., xv., xvi., xvii., and xviii., and is very well marked.

The male pores are placed in xviii.; there are no papillæ.

The oviducts open separately, very near together, in somite xiv.

I think that there are two pairs of spermathecæ in somites viii. and ix., respectively, but am a little doubtful about it.

The gizzard seemed to be in somite vii., but possibly this is a mistake for vi.

There are two pairs of groups of small nephridia opening on the posterior edges of somites vii. and viii., respectively, a little nearer the ventral line than the spermathecal pores, which occur between somites vii. and viii., and viii. and ix., respectively. I have not ascertained the number of setæ per somite, but there are large dorsal and ventral gaps.

I have found no specially modified genital setæ.

Length 400 millim., circumference 8 mm.; number of somites 332.

Hab. Naduvatam, at an elevation of about 6000 feet, in very wet ground.

I only obtained a single specimen of this very interesting worm, for which I shall make a special search on a future occasion.

[1] Ann. & Mag. Nat. Hist., Oct. 1883, p. 217.

Perichæta stuarti, sp. n.

The clitellum extends over somites xiv., xv., and xvi.; it is very well marked.

There are two pairs of male pores in somites xvii. and xix., respectively; these are all four placed upon a whitish, slightly depressed patch, which thus extends over the greater portion of somite xvii., the whole of somite xviii., and the greater portion of somite xix. Connected with each of these pores is a large coiled prostatic gland, which extends backwards in each case through some 8 or 9 somites.

There is a single median oviducal pore in the anterior portion of somite xiv.

There are two pairs of spermathecæ, situated in somites vii. and viii., respectively. They do not possess any appendages, but present a sort of frilled appearance around the base.

The gizzard is situated in somite x.

In somites xxiii.–xxvi. (?) there are four pairs of special diverticula on the dorso-lateral portions of the intestine.

I have not observed any nephridia.

There are about 52 setæ in each somite arranged with small dorsal and ventral gaps; setæ are present on the clitellum.

There are no special setæ in somite xviii., but in the anterior portion of somite viii. (*i. e.* between the anterior and posterior pair of spermathecæ) there are two groups of large modified setæ. Where these project on the surface, there is a papilla which in some specimens becomes very well marked.

Length 148 millim., circumference 15 mm.; number of somites 111.

Hab. Yercaud, at an elevation of about 5000 feet, and also down the ghaut as low as Salem (1000 ft.). I have specimens from Salem.

This is an exceedingly common worm in this region. It occurs in dry ground, and often under large stones.

Perichæta burliarensis, sp. n.

The clitellum extends over somites xiv., xv., xvi., and xvii., and is well marked.

The male pores are situated in somite xviii.; segments xix., xx., xxi., and xxii. bear papillæ (apertures ?).

The oviducts open in somite xiv. by a single median pore.

The spermathecæ are placed in somites vi., vii., viii., and ix.; they present a single appendage. I am unable at present to say anything about nephridia.

The gizzard is situated in somite x. There are a single pair of intestinal cæca in somite xxvi., reaching forwards to somite xxiv. There are 38 to 40 setæ per somite. Setæ are entirely absent from the clitellum. I find no special setæ in somite xviii., but there are two pairs of groups of enlarged setæ in somites vii. and viii., respectively.

There is a large ventral gap, especially in the somites immediately following the male pores, where the most ventrally placed setæ are larger than the others.

Length 100 millim., circumference 9 mm.; number of somites 123.
Hab. Burliar, 2000–3000 ft.

PERICHÆTA HULIKALENSIS, sp. n.

The clitellum extends over somites xiv., xv., xvi., and xvii., and is well marked.

The male pores are situated in somite xviii., and are rather near together, and placed upon slight papillæ.

The oviducts open by a single median pore in somite xiv.

The spermathecæ are placed in somites vii. and viii.; they present a single filiform appendage.

No nephridia were observed.

I believe intestinal diverticula are present in the usual position.

There are about 42 setæ per somite. The ventral gap is equal to 4 ordinary gaps, and the dorsal gap to 7 ordinary gaps. Setæ are present on the clitellum.

No special setæ were observed.

Length 200 millim., circumference 9 mm.; number of somites 209.
Hab. Hulikal-drug, Nilgiris. Elevation about 6000 ft.

PERICHÆTA MIRABILIS, sp. n.

The clitellum extends over somites xiv., xv., and xvi., and is well marked.

The male pores are widely separated, and situated on low papillæ in somite xviii.

The oviducts open by a median pore in somite xiv.

The spermathecæ are situated in somites vi., vii., viii., and ix.; they present a single appendage. They open, as is usually the case, exactly between the somite in which they lie and the preceding somite.

The gizzard is situated in somite x.

Intestinal cæca are present in somite xxvi., and run forwards.

Nephridia seem to be present in certain anterior somites only, as in *P. gracilis*.

There are four pairs of groups of small nephridia in the posterior portions of somites v., vi., vii., and viii., respectively, and these open on minute circular papillæ which are placed in diamond-shaped depressions lying in the posterior portion of the somites, in which the nephridial groups lie, and just ventrad of the nephridiopore which lies between each of the somites and the succeeding somite.

There are further two pairs of groups of nephridia lying in somites vii. and viii., respectively, and opening on similar papillæ placed ventrad of those above described, and just anterior to the seta-ring in each somite. The further details with regard to this remarkable arrangement I hope to work out on a future occasion. I may mention here that I at first mistook these nephridiopore-bearing papillæ for the pores of the spermathecæ, and it is quite possible that previous observers have done the same thing in other species of *Perichæta*. It needs the most careful and repeated observation to make out the exact arrangement. There 39 setæ per somite, with no gap either dorsally or ventrally. It is always possible, however, to recognize the median ventral or dorsal lines, as both ventral and dorsal

setæ point forwards and away from the middle line, while the lateral setæ point straight forwards. I lay no stress on this arrangement at present; it may be caused by my method of flattening out the body-wall after a median dorsal incision. I have no observations with regard to penial setæ.

Length 130 millim., circumference 8 mm.; number of somites about 114.

Hab. Naduvatam, Nilgiris. Found along with *P. gracilis*.

I hope to make some special observations at a later period with regard to the distribution of these worms, but I may point out now that the only two species presenting this remarkable arrangement of nephridia, while differing in almost all other essentials, were found together.

Perichæta salettensis, sp. n.

The clitellum extends over somites xiv., xv., xvi., and xvii., and is well marked.

The male pores are situated on somite xviii., without much ridge around them.

The oviducts open by a median pore in somite xiv.

The spermathecæ lie in somites vii., viii., and ix.; they present a pair of small appendages.

The gizzard is situated in somite vi.

I have no observation regarding intestinal cæca.

The nephridia occur in, at any rate, most of the somites; they are very large and present rosettes of tubules in certain anterior somites.

The setæ present a dorsal gap equal to about three ordinary gaps, and a ventral gap equal to about five ordinary gaps. There seem to be no modified penial setæ.

Length 70 millim., circumference 9 mm.; number of somites 112.

Hab. Salem, elevation about 1000 feet, in wet ground together with *P. bivaginata*; I only found two specimens.

Perionyx saltans, sp. n.

The clitellum extends over somites xiv., xv., and xvi. In the hitherto known species of *Perionyx*, *P. excavatus*, E. P.[1], and *P. macintoshii*, Bedd.[2], the clitellum extends over somites xiii., xiv., xv., xvi., and xvii.

The male pores are situated on papillæ in a median pit in somite xviii.

The oviducts open by a single median pore in somite xiv.

There are three pairs of spermathecæ; these are placed in somites vi., vii., and viii. The spermathecal pores are placed between somites vi., and vii., vii. and viii., viii. and ix. This is an unusual arrangement, the spermatheca generally opens between the somite in which it lies and the somite in front. Each spermatheca presents two minute appendices. The spermathecal pores are placed very near the median line; in all the *Perichæta* species they are very lateral in position.

[1] Nouv. Arch. d. Muséum, t. viii. 1872, p. 126.
[2] Ann. & Mag. Nat. Hist., Oct. 1883, p. 217.

The nephridia are small and present a unique arrangement. The nephridiopores are all placed on the anterior edge of a somite. They are placed in two rows on each side, an inner and an outer row. The inner row is about in a line with the 11th setæ. Counting from the median ventral line, the outer row is about in a line with the 17th setæ, while the spermathecal pores are in a line with the 4th setæ.

In somite iv. there is a single nephridiopore on the left-hand side, in somite v. there is a single pore on the right-hand side, in somite vi. there is a single pore on the left-hand side; these three pores all belong to the inner rows. In somite vii. I found no pore. The remaining somites each present two pores. In somites viii., x., xii., xiv., &c. the pore on the right side belongs to the outer row, and the pore on the left side to the inner row. In somites ix., xi., xiii., xv., &c. the reverse arrangement obtains, viz., the left-hand pore belongs to the outer row and the right-hand pore to the inner row.

In too many cases we do not, unfortunately, know the position of the nephridiopore: I have not access out here to the description of *Plutellus*[1], but the nephridiopores are there said to alternate in position; with this exception the arrangement is unique and bears a most interesting relation to the theory that the spermathecæ are modified nephridia. It will be noted that the distances between the outer and inner rows of nephridiopores, between the inner row of nephridiopores and the row of spermathecal pores, and, lastly, between the rows of spermathecal pores, are almost exactly equal, and the pores have exactly similar positions in the somite.

I have made no observations on the alimentary canal.

There are 45–54 setæ in each somite arranged in an almost continuous ring.

Setæ are present on the clitellum. No modified genital setæ were observed.

Length 60 millim., circumference 6 mm.; number of somites 61.

Hab. Ootacamund; Naduvatam, Nilgiris. Elevation about 6500–7500 feet.

It is a very strong little worm, and the name refers to its power of leaping into the air when touched.

Moniligastridæ.

The huge worm which is mentioned in Darwin's book as occurring on the Nilgiris turned out to be a *Moniligaster*, a form then known from Perrier's description of a single specimen which he called *M. deshayesii*. I have since received information that Mr. Beddard has described another species from Ceylon as *M. barwelli*[2].

I found, in addition to the large worm, four smaller species of *Moniligaster* on the Nilgiris, and two others on the Shevaroys or rather at Salem, at the foot of the ghaut.

I have thus recognized seven species altogether, but it is exceedingly difficult to characterize these accurately until we know their general organization better, so that I regard the following very scanty descriptions as preliminary.

[1] Arch. de Zool. Exp. t. ii. (1873).

[2] Ann. & Mag. Nat. Hist., Feb. 1886, p. 940.

Moniligaster has been described as being devoid of any clitellum. In, at any rate, one of my species the clitellum is, however, very well marked, so that this cannot be taken as a generic character.

The genus is, however, sufficiently characterized by the four pores situated in pairs between somites vii. and viii., and x. and xi., respectively, by the peculiar arrangement of the generative organs, and by the monilated gizzard. It is often exceedingly difficult to determine the exact position of the gizzard, and I believe that its position may vary by a somite in different individuals of the same species; still there is no doubt that in some cases it will serve as a specific character—e. g. *M. sapphirinaoïdes* and *M. robustus*, which resemble one another in most respects, differ markedly in the position of the gizzard.

There is a great difference in size among the species; *M. grandis* is quite as large as *Microchæta rappi*, while *M. minutus* is one of the smallest of Earthworms.

MONILIGASTER GRANDIS, sp. n.

There is no trace of clitellum.

The distance between the ventral seta rows is greater than that between the ventral rows and the lateral rows.

The gizzard extends through somites xvii.–xxi. inclusive.

The septa between v.–vi., vi.–vii., vii.–viii., and viii.–ix. are very strong and thick.

The septum between ix. and x. is absent.

I obtained this worm in May and June. In May, before the rains, I only found it deep down: I have made coolies dig pits as much as 9-10 feet deep before coming upon a single worm, although their burrows were quite obvious; then one would suddenly come upon a specimen lying in a hollow which seemed to exactly fit its body, all rolled up together in a mass nearly the size of one's fist, and upon the surface of the body, crawling about in the mucous, were young individuals which in one instance were less than half an inch long, but from larger specimens I easily determined them to be young *Moniligasters*. I expect that there is something very interesting about this, and probably it is connected with the absence of clitellum and consequently of cocoons, but it seemed to be too late in the year to make any further observations.

In June at Naduvatam, after there had been some rain, I found these worms quite near the surface, even in some cases crawling about, but I never then found young ones. I never found these worms at a lower elevation than 6500 feet; at Coonoor, which is just below that altitude, and much warmer than Ootacamund, I could not find a single specimen.

MONILIGASTER UNIQUUS, sp. n.

So called because for some time I had only a single specimen, but I subsequently found a few others.

There is no clitellum.

The gizzard occupies somites xv.–xix.

The ventral seta rows are very near together, there is less distance

between them than between a ventral row and the lateral row of the same side.

It is a small weak-looking worm.

I found specimens at Ootacamund and at Naduvatam.

Moniligaster sapphirinaoïdes, sp. n.

This worm presents a well-marked clitellum extending over somites x., xi., xii., and xiii.

The gizzard occupies somites xvii.–xxi.

This is a very strong active worm, rather larger than a big English *Lumbricus agricola*, and presents most exquisite iridescent colours, among which a metallic bluish-green is the most marked.

I found it in immense numbers in some very wet black mud under turf near the Pykarah Waterfalls, at, I believe, an elevation of about 6000 feet. When placed in spirit it becomes olive-green in colour, while the clitellum becomes almost pinkish.

Moniligaster robustus, sp. n.

The gizzard occupies somites xi.–xv.

This worm is easily recognized by its very pointed posterior extremity, just the anal somites being bright pink, while the rest of the worm is dull in colour. In other respects it resembles *M. sapphirinaoïdes*.

I found a few specimens only, crawling across a path on a drenching day, on top of one of the hills at Ootacamund.

Moniligaster papillatus, sp. n.

This species is characterized by long tubular papillæ in connection with the pores between somites x. and xi.

The gizzard occupies somites xvi.–xx.

I found this at Ootacamund and Coonoor.

This is a much longer worm than any of the other species, with the exception of *M. grandis*.

Moniligaster ruber, sp. n.

The gizzard seemed to occupy only somites xiii. and xiv. In somites x., xi., and xii. there were soft-walled swellings of the intestine looking like gizzard, only not muscular. The worm had a thin body-wall, and the organs showing through give it a blood-red appearance. It is a small worm about 100 millim. long.

I obtained only a single specimen from Salem.

Moniligaster minutus, sp. n.

The gizzard occupies somites xii., xiii., and xiv.

This is a small worm resembling *Perionyx saltans* in appearance, but not very active. The ovaries, or at any rate sacs containing ripe ova, occupy somites xii.–xv. at least.

I found numerous specimens in wet ground at Salem.

When I have determined more accurately the structure of the generative organs in this genus, this species will probably prove an interesting one.